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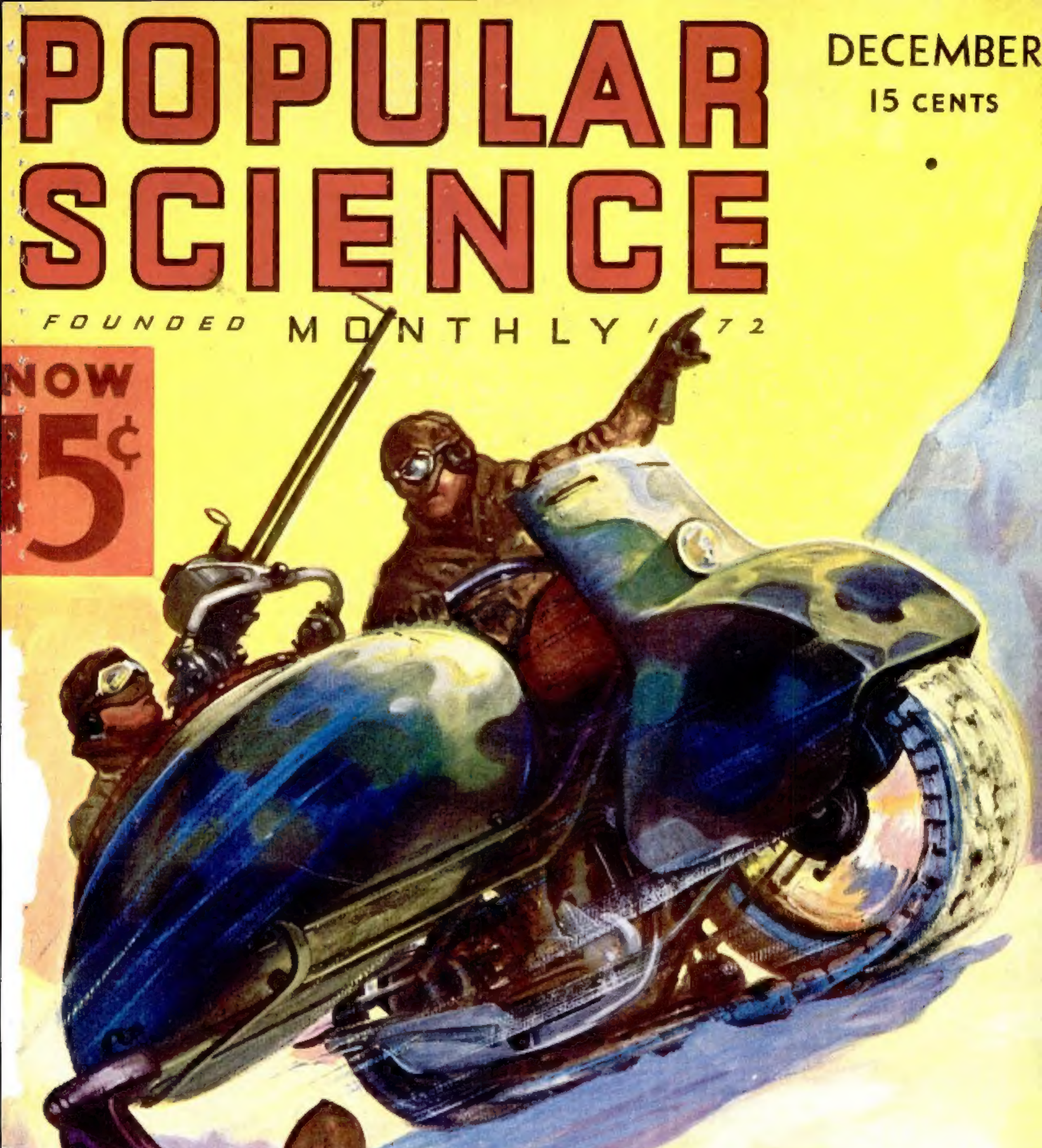

NEW INVENTIONS
MECHANICS
THE HOME WORKSHOP
MONEY MAKING IDEAS
350 PICTURES

See Page 45

Here's the Guarantee

THAT WON'T "EVAPORATE"

FIND YOUR CAR ON THIS CHART

IMPORTANT! The price per gallon of an anti-freeze means nothing unless you know *how many gallons* you will need during the *entire* winter. You can't get that information on a boil-away anti-freeze. But you can get it for Eveready Prestone . . . and here it is. See how reasonably you can get two-way protection *all winter long* against both freeze-up and rust with *one shot* of Eveready Prestone—one shot because it won't boil off, no matter how warm the weather gets between the cold snaps. If your car isn't on this chart, your dealer has a chart showing all cars and amounts needed for temperatures to 60° below zero.

Find your car and read from left to right. The first figure shows the protection you get with one gallon of Eveready Prestone in the cooling system; the second with one and a half gallons—and so on. "+" means above zero. "—" means below zero. If your car has a hot water heater, add ¼ gallon to the quantity called for.

MODEL	1 GAL.	1½ GAL.	2 GAL.	2½ GAL.
Auburn				
6-52, '34; 6-54, '34; 6-54, '35	+12	− 4	−27	−59
8-100, '33; 8-101, 8-105, '33	+15	+ 2	−16	−42
850, '34; 852, '35; 852, '36	+17	+ 6	− 9	−28
Buick				
40, '34, '35, '36	+ 6	−14	−34	
60, '32; 80, '33, '34, '35	+10	− 8	−34	−62
80, 90, '36	+12	− 4	−27	−59
90, 90, '32; 60, '33, '34, '35	+15	+ 2	−16	−42
80, 90, '33; 90, '34, '35	+19	+ 9	− 3	−19
Cadillac				
370-D, '34, '35	+14	0	−21	−50
355-D, '34, '35; 80, 85, '35	+16	+ 4	−12	−34
452-D, '34, '35; 90, '36	+19	+ 9	− 3	−19
370-A, '31; 355-B, '32; 355-C, '33	+21	+13	+ 1	− 9
60, 70, 75, '36	+22	+15	+ 5	0
Chevrolet				
Stand; '33, '34, '35	−12	−62		
Master; '33, '34, '35	− 6	−47		
'31, '32	0	−34	−62	
All Models—'36	+ 8	−12	−43	
Chrysler				
6-'32, '33, '34, '35	+13	− 4	−27	−59
8-'31, '32; AF, Imp. '35; 6-'36	+15	+ 2	−16	−42
Roy. 8, Imp. 8, '33; Air 8, '35	+16	+ 4	−12	−34
70, '34; DeLuxe 8, '36	+18	+ 8	− 6	−23
De Soto				
6, '31, '32, '33; 8, '31	+10	− 8	−34	−62
6, '34; Airflow 6, Airstream 8, '36	+10	+ 4	−12	−34
Airflow, Airstream, '35	+12	− 4	−27	−59
Dodge				
6, '32, '33, '34, D2, '36	+ 8	−12	−43	
Senior 6, '30; DU, '36	+12	− 4	−27	−59
8-'32, '35	+15	+ 2	−16	−42
Ford				
A, '30, '31; B, '32, '33	0	−34	−62	
V-8, '32, '33, '34, '36	+18	+ 8	− 6	−23
V-8, '35	+16	+ 4	−12	−34
Graham				
80, 90, 110, '36	+10	− 8	−34	−62
72-Spl. 6; 72-8, '35	+14	0	−21	−50
74 6, '35; 80, '36	0	−34	−62	
6, 8, '33; 6, 8, '34; 78, '35	+16	+ 4	−12	−34
Hudson				
6, '36	+ 2	−25	−62	
8, '31, '32, '33; 6, '35	+12	− 4	−27	−59
8, '35, '36	+17	+ 6	− 9	−28
8, '34	+19	+ 9	− 3	−19
Hupmobile				
18, '31; Cent. 8, '32; 321, '33	+10	− 8	−34	−62
417, 421, '34; 521, '35	+10	− 6	−34	−62
322, '33; 422, '34; 518, '35;	+17	+ 6	− 9	−28
6-616-G '36	+17	+ 6	− 9	−28
326, '33; 426, '34; 527, '35;	+19	+10	0	−15
6-621-S '36	+19	+10	0	−15

MODEL	1 GAL.	1½ GAL.	2 GAL.	2½ GAL.
Lafayette				
'34; '35; '36	+13	+ 2	−16	−42
La Salle				
50 (Ser. 8) '36	+10	− 8	−34	−62
350, '34; 35-50, '35	+15	+ 2	−16	−42
345-B, '32; 345-C, '34	+21	+13	+ 1	− 9
Lincoln				
Zephyr, '36	+21	+13	+ 4	− 7
136, '34, '35, '36; 345, '34, '35, '36	+23	+17	+10	− 2
Nash				
80, 70, '31; 960, 970, '32	+ 2	−25	−62	
1130, 1070, 1170, '33; 1220, '34	+12	− 4	−27	−59
3620, 3640, 3640A, '36	+14	0	−21	−50
1280, '34; 3580, '35; 1080, 1180, '35	+17	+ 6	− 9	−28
Oldsmobile				
F-30, '30; F-31, '31; F-35, '33;	+ 2	−25	−62	
F-36, '36	+ 2	−25	−62	
F-33, L-32, '32; F-33, '33;	+12	− 4	−27	−59
L-35, '35; L-36, '36	+12	− 4	−27	−59
L-33, '33; L-34, '34	+15	+ 2	−16	−42
Packard				
120-'35, '36	+14	0	−21	−50
Sup. 8, '33; '34; 8, '33, '34, '35	+16	+ 4	−12	−34
Sup. 8, '35	+18	+ 8	− 6	−23
745, '30; 846, '31; DeLuxe, '32	+21	+13	+ 1	− 9
12, '33, '34, '35, '36	+25	+21	+19	+ 5
Pierce Arrow				
41, 42, 43, '31; 54, '32; 836-A, '34	+21	+13	+ 1	− 9
1601-8, '36	+21	+13	+ 1	− 9
840-A, '34; 845, '35	+22	+15	+ 5	− 1
1602-03 (12), '36	+24	+20	+15	+ 9
Plymouth				
'30; PF, PG, '34	+ 6	−18	−54	
PA, '31; PB, '32; PE, '34; PJ, '35;	+10	− 8	−34	−62
P1, P2, '36	+10	− 8	−34	−62
PC, PD, '33	+ 2	−25	−62	
Pontiac				
'30; '31; 6-'32; '35	+ 6	−18	−54	
8-'33, '34, '35; 6-'36	+ 8	−12	−43	
8-'36	+12	− 4	−27	−59
Reo				
6-21, 6-25, '32; SC '35; Roy. '35;	+15	+ 2	−16	−42
6D, '36	+15	+ 2	−16	−42
8-25, '32; 8-3, '33; 6-6, '34	+16	+ 4	−12	−34
Studebaker				
Dict. 6, '36	+ 6	−18	−54	
Comm. 8, '31, '32, '33;	+10	− 8	−34	−62
Dict. 6, '34, '35	+10	− 8	−34	−62
Dict. '31, Comm. 8, '34,	+14	0	−21	−50
Pres. 8, '33, '34, '36	+14	0	−21	−50
Pres. 8, '31, '32, '35; Comm. 8, '35	+17	+ 6	− 9	−28
Terraplane				
6, '32, '33; 6 Spec. '35; 6, '36	+ 2	−25	−62	
8, '33; 6 DeLuxe, '35	+10	− 8	−34	−62
6, '34	+14	0	−21	−50

NATIONAL CARBON COMPANY, INC.

specifically

GUARANTEES

that Eveready Prestone, if used according to printed directions, in normal water cooling systems, will protect the cooling system of your car against freezing and clogging from rust formations for a whole winter; also that it will not boil away, will not cause damage to car finish, or to the metal or rubber parts of the cooling system, and that it will not leak out of a cooling system tight enough to hold water.

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Many brands of anti-freeze are being marketed under various names. Most of them are based on alcohol, and because they are not plainly labeled, it is easy to become confused. So before you buy any anti-freeze, just ask your dealer how much alcohol it contains. For alcohol—no matter how it is treated or what it is called—is subject to evaporation, leaving you without protection.

But you won't have to worry if you get Eveready Prestone. It contains no alcohol, is definitely guaranteed.

The words "Eveready Prestone" are the trade mark of National Carbon Co., Inc.

$2.70 A GALLON

Won't boil off . . . contains no alcohol

First Pictures & Details About the

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THE BIGGEST, ROOMIEST PLYMOUTH EVER BUILT_New Sound-proofing of Steel Roof and Floor_Shuts Out Road Noises_New Safety Interior_Entire body Pillowed on Live Rubber_Eliminates Vibration and Rumble_New Airplane-type Shock-Absorbers_New "Hushed Ride"_Tests Show 18 to 24 Miles Per Gallon of Gas.

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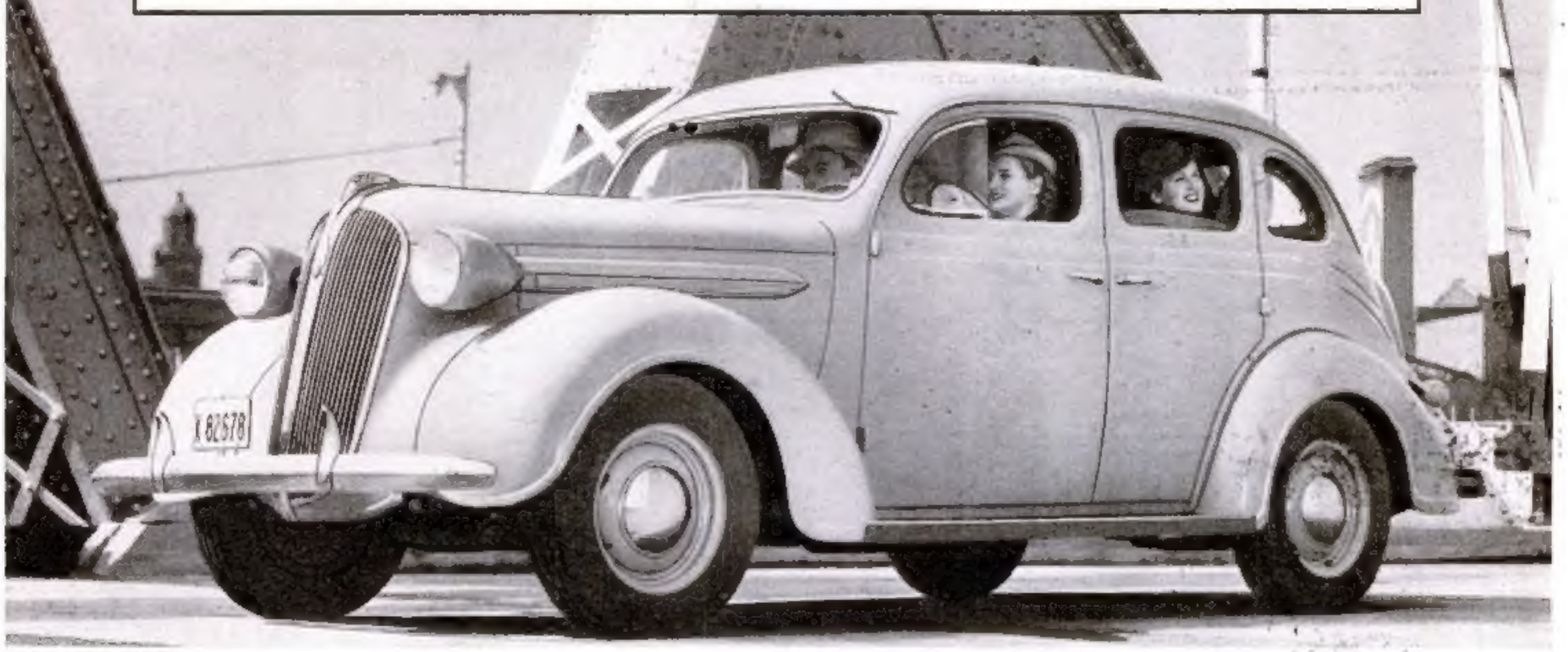

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FOUNDED MONTHLY 1872

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FEATURES AND DEPARTMENTS

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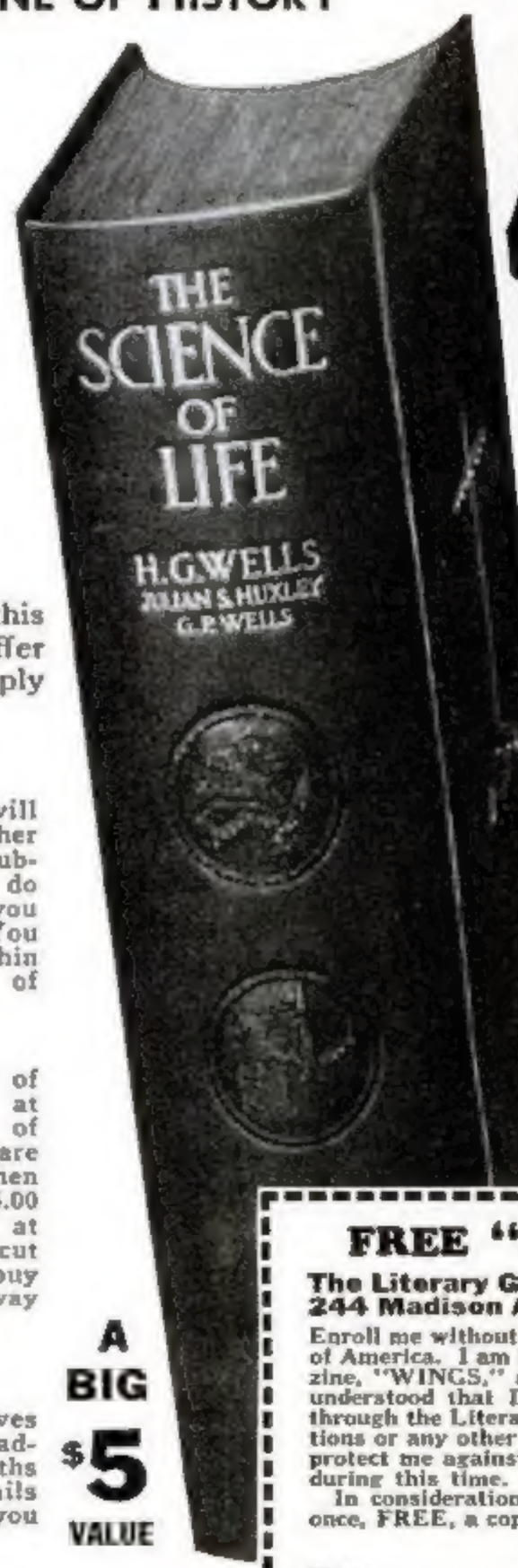

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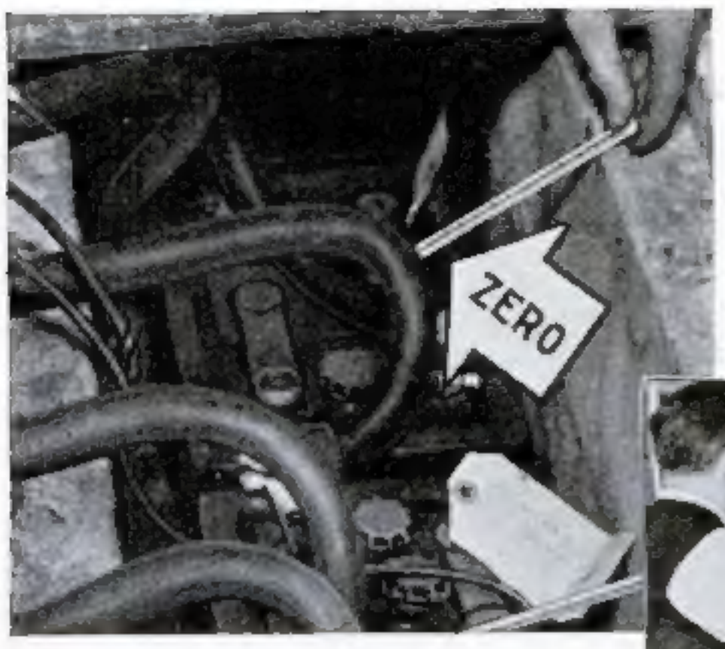
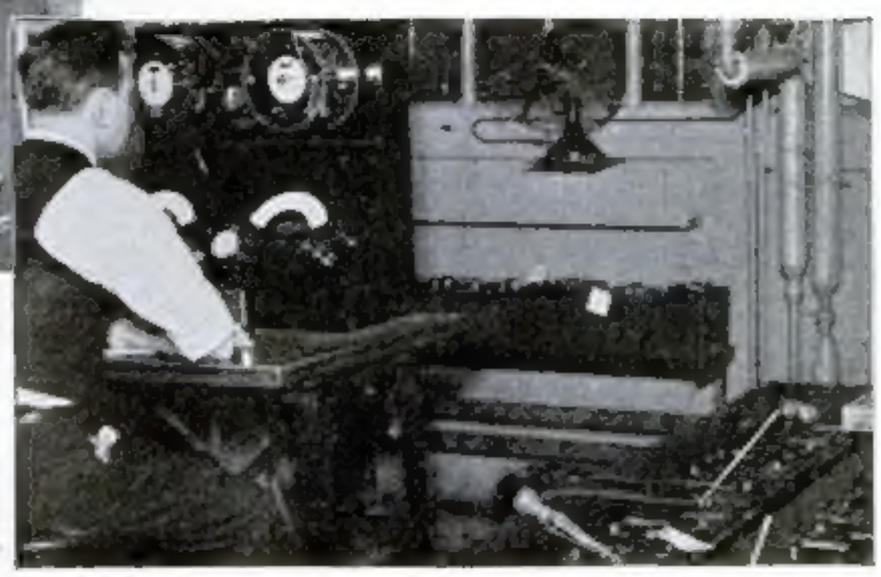
POPULAR SCIENCE MONTHLY FOR DECEMBER, 1936

RIGID TESTS PROVE QUALITY OF *Genuine* Ford Batteries



Genuine Ford Batteries undergoing the cold test in refrigerator where zero temperature is maintained, at the Ford Battery Testing Laboratory at Dearborn, Michigan.



These sensitive meters accurately measure battery capacities. The batteries in the tank to the right are undergoing a normal discharge test.

The high-rate discharge test — equivalent to holding down the starter button for eight minutes.

IMAGINE holding down the starter button on your car for eight minutes! Imagine discharging and recharging your battery 45 times with an overcharge of 100 per cent each time! Imagine overcharging your battery at a 10-ampere rate continuously day and night for thirty days!

Hard on your battery? Yes! Yet these are only a few of the severe laboratory tests that Genuine Ford Batteries, used in Ford cars and trucks, must pass. It's no wonder that millions of Genuine Ford Batteries in service throughout the world have proved their ability to give long, trouble-free service — even on the toughest jobs.

Plates used in Genuine Ford Batteries are of the highest quality materials. They have exceptionally large areas. Only vertical-grain wood separators are used. Posts are fused to lead inserts in the cover to provide additional strength. And cell covers rest on ledges in the case to provide better support for the elements inside.

Regardless of the car or truck you drive, when your battery must be replaced, remember that with a Genuine Ford Battery you can be certain of Ford quality, Ford standards of workmanship and Ford rigid inspections and tests. You can be certain of genuine satisfaction.

FORD MOTOR COMPANY, DEARBORN, MICHIGAN

GENUINE Ford PARTS & ACCESSORIES

The complete line of Genuine Ford Batteries consists of a 13-plate battery, two 15-plate batteries and one 17-plate battery. The last is used as standard equipment in Ford cars and trucks.

Type A
13 plate

Type 40
17 plate

Type B
15 plate

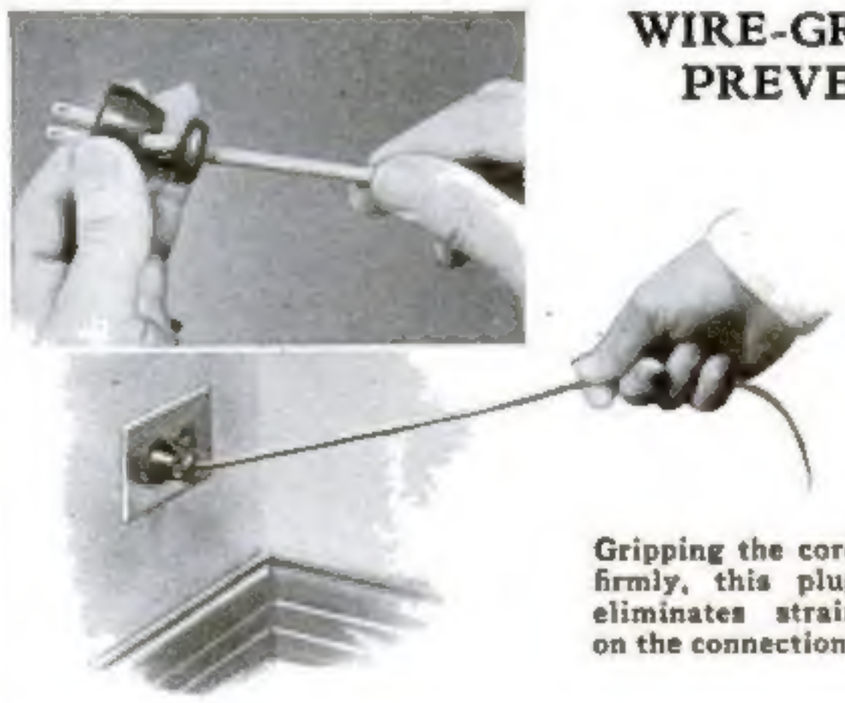
Type 40-D
15 plate

Pressed-metal plumbing fixtures, now available, are so light one man can carry two large units

New Building Aids

FOR THE HANDY MAN

PRESSED-METAL bathtubs, sinks, and other plumbing fixtures that weigh only one third as much as conventional cast types have recently been placed on the market. With the lightweight units, additional bathrooms now can be installed in existing homes where the original floor beams and supports were not designed to bear the added load of cast-iron tubs and sinks. According to experienced builders, the new fixtures may prove an important factor in reducing the floor loads in small homes, an important consideration under modern methods of construction.



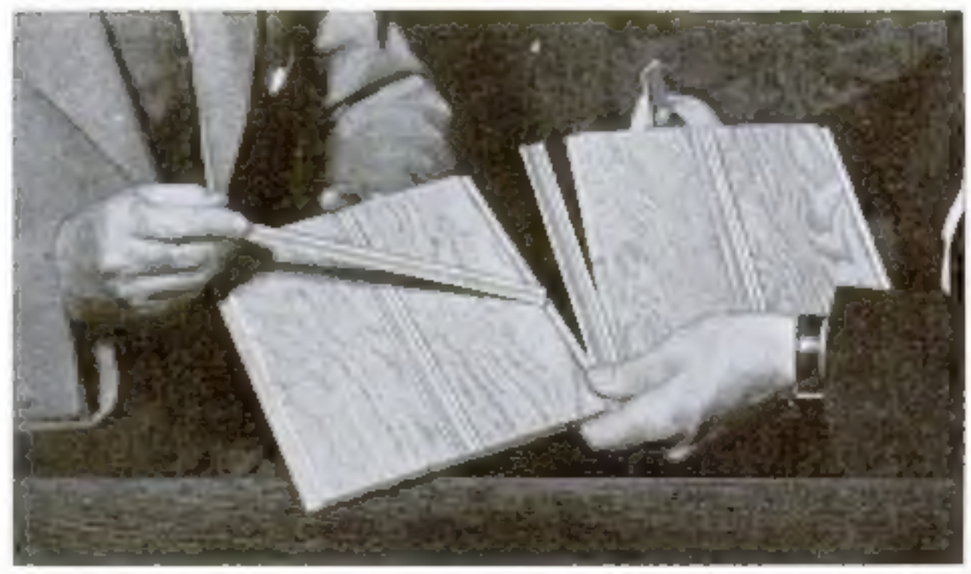
Gripping the cord firmly, this plug eliminates strain on the connections

WIRE-GRIPPING ELECTRIC PLUG PREVENTS SHORT CIRCUITS

TWISTING the connecting cord into a special hook slot on the top of a new electric plug anchors it so firmly that no amount of pulling or jerking will loosen the terminal wires. Short circuits, shocks, and blown fuses caused by loosened connections are entirely eliminated, making it safe, as well as easy, to pull the cord instead of the plug when disconnecting an electrical appliance from a wall outlet so located that it cannot be reached with the hand.

WALL PANELING HAS CONCEALED JOINTS

WITH a new type of plywood wall board recently developed, rooms can be paneled without the use of moldings to hide the joints. Thin inlay strips of matching woods fit into grooves rabbeted in the edges of each section. Because the inlay strips fit snugly and are flush with the wall surface, no panel joints can be detected on the completed job, giving a smooth, continuous surface when painted or finished.



Sections of wall board, and inlay strips that hide the joints

Questions

FROM HOME OWNERS

Q.—I HAVE a brick retaining wall beside my one-car garage, and it has been coated with asphalt for waterproofing. In hot weather, it wrinkles and runs. Is there any finish that can be applied to stop this and improve its appearance?—H. K. P., Baltimore, Md.

A.—ALTHOUGH nothing can be done to prevent the heat of the sun from softening the asphalt, the appearance of the wall can be improved by applying a coat of whitewash mixed in the proportions of fifteen pounds of salt, seven and one half gallons of water, and fifty pounds of hydrated lime.

WATER SPOTS ON A CEILING

W. R., ST. LOUIS, MO., Rain or water spots on a ceiling that is to be refinished generally can be removed by brushing on a mixture of unslaked lime and denatured alcohol. When the liquid has dried, the surface can be repainted.

LOOSENING FURNACE SOOT

G. H. L., MILWAUKEE, WIS. Most commercial preparations sold for use in a furnace to remove soot contain zinc as a basic ingredient. An old door-bell battery thrown into the furnace fire will produce a similar result; the zinc fumes from the battery combining chemically with the furnace gases to loosen the soot scale.

PAINT IN SMALL QUANTITIES

T. F., YOUNGSTOWN, OHIO. Small quantities of colored paints can be obtained by mixing white lead with the proper pigment. For a pink, Venetian red should be used; for grays, lampblack.

CONCRETE WORK IN WINTER

P. D., ALBANY, N. Y. If it is absolutely necessary to lay concrete in cold weather, heat the aggregate and sand before mixing by spreading it out on a sheet of iron laid on bricks or rocks, under which a fire has been built. The water used also should be heated, if possible. The finished concrete should be covered with straw and manure.

REFRIGERATOR CURRENT COST

Q.—HOW can I figure the cost of the electricity used by my electric refrigerator?—B. M., Atlanta, Ga.

A.—THE COST of operating any electric appliance can be figured by multiplying the rated current (amperes) by the voltage rating, the time in hours used, and the cost of a kilowatt hour. In the case of a refrigerator, whose operation is automatic, the actual time that electricity is flowing into the compressor motor can be measured by connecting an ordinary self-starting electric clock to the two wires leading to the motor. When the motor runs, the clock will run, and the accumulated time will be indicated on the dial. The test can be made for twenty-four hours, and the total multiplied by 365 to obtain the total time for a year.

FIGURING HEAT RADIATION

J. W., SEATTLE, WASH. Although the size of radiator needed to heat a room comfortably depends on the number and size of the windows, the wall area, and the general location of the house, an estimate can be made by figuring one square foot of radiator surface for every forty cubic feet of room volume. For hot-water heat, the radiator surface should be doubled.

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Aromatics	Food Specialties	Oil Sun-Tan
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Bronze Lacquers	Glass Polish	Paints
Candies	Glues	Patent Leather
Candy Glaze	Gold, Plating	Photographic Specialties
Carbonizing	Grease, Lubricating	Polish, Auto
Catalysts	Hair Setting Liquids	Porcelain
Celluloid	Hair Tonics	Preservatives
Cement	Incense	Printing
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Construction Kits

FOR WHITTLED NOVELTIES
•
SHIP MODELS
•
FURNITURE
•

Gaspard the sailor, who is easily made from materials in our new kit No. 9, shown in the circle

BECAUSE whittling is again becoming a popular pastime, we offer three construction kits for those who enjoy transforming a block of soft white pine into an attractive hand-carved ornament—and for those who have never tried it, but would like to learn how. Gaspard the sailor, illustrated above, is the subject of our newest kit, No. 9. The other whittling kits are No. 7, for making Skipper Sam'l, a quaint old sea captain, and No. 8 with six varieties of Scotty dogs.

If you are one of the many readers who have already whittled the sea captain, you will certainly want to make Gaspard, who is equally picturesque and may, indeed, have served on one of Skipper Sam'l's ships. The easiest way to do this is to get kit No. 9, because it contains a block already sawed to Gaspard's approximate shape so that no heavy cutting is required. In the kit are also a sharpening stone, brush, and black, white, and red paint. The price is only 75 cents, which makes the kit one of the most inexpensive in the entire list.

You'll probably want to keep Gaspard, Skipper Sam'l, and the six Scotties when you have made them, but they also make excellent novelties for Christmas gifts.

If you prefer model making, there is still time to make one of our simpler ship models for Christmas. And don't forget that a good many men and boys would appreciate receiving a kit so that they can have the pleasure of building a model themselves. Possibly some member of your family has already shown an aptitude for model making. If so, find out what kind of model he would prefer to construct and get him a kit. Then he will have everything he needs in one package.

The complete list of our kits is as follows:

MODEL-OF-THE-MONTH KITS

M. Aircraft carrier *Saratoga*, 18-in.....$1.00
N. Four U.S. destroyers, each 6¼-in. .75

(Continued on page 9)

SKINNY? THOUSANDS GAIN 10 TO 25 LBS. NEW EASY WAY

Posed by professional model

NEW IRONIZED YEAST OFTEN ADDS POUNDS *—in a few weeks!*

EVEN if you never could gain, remember thousands have put on solid, naturally attractive flesh with these new, easy-to-take little Ironized Yeast tablets—*in just a few weeks!*

Not only has this new discovery brought normally good-looking pounds, but naturally clear skin, freedom from indigestion and constipation, new pep.

Scientists recently discovered that thousands of people are thin and rundown for the single reason that they do not get enough Vitamin B and iron in their daily food. Now the richest known source of this marvelous body-building, digestion-strengthening Vitamin B is cultured ale yeast. By a new process the finest imported cultured ale yeast is now concentrated 7 times, making it 7 times more powerful. Then it is combined with 3 kinds of iron, pasteurized whole yeast and other valuable ingredients in pleasant little tablets called Ironized Yeast tablets.

If you, too, need these vital elements to build you up, get these new "7-power" Ironized Yeast tablets from your druggist today. Then day after day, watch flat chest develop and skinny limbs round out to natural attractiveness. Constipation and indigestion from the same cause vanish, skin clears to normal beauty—you're a new person.

Money-back guarantee

No matter how skinny and rundown you may be from lack of sufficient Vitamin B and iron, try these new Ironized Yeast tablets just a short time. See if they don't build you up in just a few weeks, as they have thousands of others. If you are not delighted with results of very first package, your money will be instantly refunded.

Special FREE offer!

To start thousands building up their health right away, we make this FREE offer. Purchase a package of Ironized Yeast tablets at once, cut out the seal on the box and mail it to us with a clipping of this paragraph. We will send you a fascinating new book on health, "New Facts About Your Body." Remember, results with the very first package—or money refunded. At all druggists. Ironized Yeast Company, Inc., Dept. 4512, Atlanta, Ga.

OUR CONSTRUCTION KITS

(Continued from page 8)

O. Liner S.S. *St. Louis*, 11-in..... 1.00
R. U. S. cruiser *Tuscaloosa*, 11¾-in... 1.00
U. *Hispaniola*, the ship in "Treasure Island," 7-in. ..... .50
Z. H.M.S. *Bounty*, 11½-in..... 1.50
1M. Show boat, illuminated, 14-in..... 1.50
2M. Ocean freighter, 14-in..... 1.50
3M. Yacht *Nourmahal*, 8⅛-in..... 1.00
4M. Oil tanker, 14-in..... 1.50

SIMPLIFIED SHIP MODEL KITS

F. Liner S.S. *Manhattan*, 12-in..... 1.00
H. Cruiser U.S.S. *Indianapolis*, 12-in. 1.50
J. Clipper ship *Sea Witch*, 13-in..... 1.50

KIT 4M is for building this oil tanker

STANDARD SHIP MODEL KITS

A. Whaling ship *Wanderer*, 20½-in.....$7.40*
D. Spanish galleon, 24-in..... 6.95*
E. Battleship U.S.S. *Texas*, 3-ft..... 7.45*
G. Elizabethan galleon *Revenge*, 25-in. 7.25*
L. Farragut's flagship *Hartford*, steam-and-sail sloop-of-war, 33½-in. hull..... 8.45*
Q. Privateer *Swallow*, 12½-in. hull.... 4.95†
V. Clipper *Sovereign of the Seas*, 20½-in. hull ..... 4.95†
Y. Trading schooner, 17½-in. hull..... 4.90†
2S. U. S. Navy Destroyer *Preston*, 31½-in. hull 5.95*
3S. *Constitution* ("Old Ironsides"), 21-in hull 6.50*
4S. Clipper ship *Great Republic*, 31½-in. hull 8.40*
5S. Coast Guard patrol boat of new 165-ft. class. Full-hull model, ⅛ in. scale, the hull being 20⅝ in. long..... 4.95*

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No. 4. Solid mahogany book trough 22½ in. long, 9½ in. wide, and 24¾ in. high over all. Ready to assemble, with finishes..... 5.30*

No. 5. Solid rock maple hanging wall rack with one drawer, 19½ in. wide, 33¼ in. high. Ready to assemble and stain included..... 5.75*

No. 7. Whittling kit with two shaped blocks for making sea captain 5½ in. high. A knife, three bottles of paint, pocket sharpening stone, and instructions are included..... 1.50

No. 8. Whittling kit for six different Scotties. Each is 2 by 2¼ in., sawed to shape. Paint, paintbrush, instructions, etc..... 1.00

No. 9. Whittling kit with shaped block for making a sailor 5¼ in. high. Three bottles of paint, a brush, and a sharpening stone are included ..... .75

NOTE: If you live west of the Mississippi River or in Canada, add 50 cents to all prices marked with an asterisk (*) and 25 cents to all prices marked with a dagger (†).

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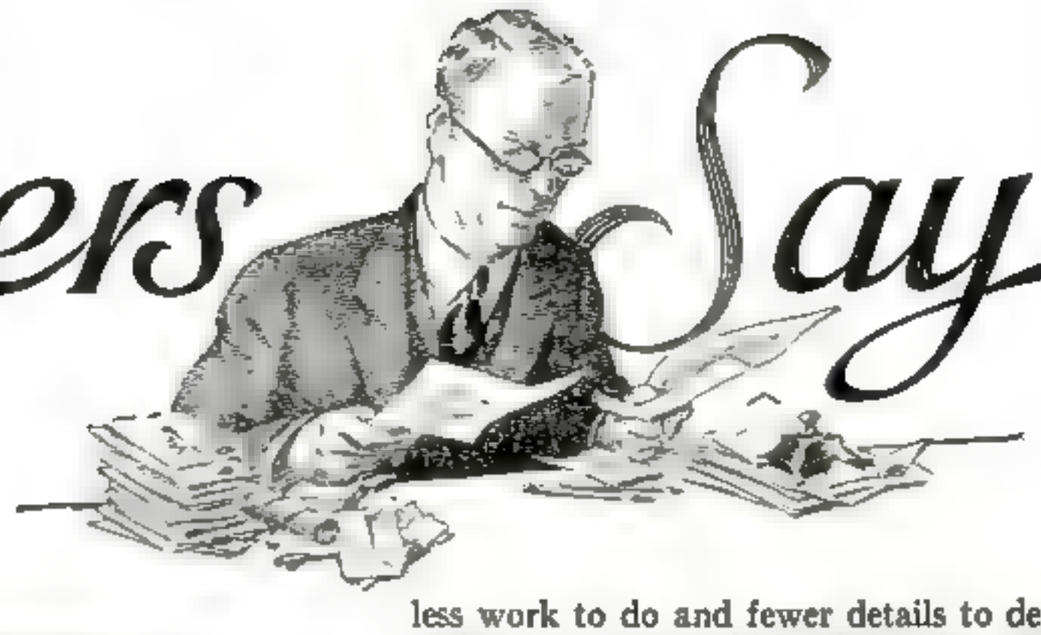
Our Readers Say



He's Got Lethargy, Not Allergy

DR. FREDERIC DAMRAU gave us a very interesting article on the mysteries of allergy, but he didn't bring it quite up to date. Not long ago, I read a report of a medical meeting at which a leading authority on this subject made a startling announcement. He said that, in addition to the more generally recognized cases in which people are made ill by eating, breathing, or touching common substances, many individuals are sensitive to heat, to cold, or even to physical exertion. The latter gave me considerable encouragement, as it affords a scientific excuse for my dislike for work. Now, when anybody reproaches me for being lazy, I say, "Oh, no, I'm just allergic to physical exertion." Sounds a lot better, doesn't it?—S. J., Atlanta, Ga.

What This Country Needs Is A "Flivver" Soap-Box Racer

WHY not give us some simplified plans for an inexpensive soap-box racer? I have a very fine hill on which to run one. A friend and I made a racer from your previous plans, but I do not have so much money, so cannot build such an elaborate one as that. We are proud of it, though, for we were "clocked" at thirty-five miles an hour.—C.A.B., Helper, Utah.

Black-Eye Remover Has His Approval

IT CERTAINLY is good to see, in your October issue, that the scientists have at last got around to inventing a machine that will remove the guilty evidence of a black eye in less than an hour. Personally, I've taken quite a few shiners, and it'll be a relief not to have to think up any more gags such as "Oh, I just ran into a door," or "I fell going upstairs." Now, how about a machine that will remedy cauliflower ears?—J.J.O'B., New York City.

Inlaid Silver Spurs For Craftwork Caballeros

ALTHOUGH I have been a reader of your magazine for a long time, this is my first request for a special article. Those who ask are more likely to get than those who do not, so here goes for my try: The article on jewelry making by W. T. Baxter gives me hope of seeing something on Mexican silverwork, particularly the inlaying and overlaying used on spurs and bits; also the hand engraving. I realize that I am only *one* subscriber, so if you don't think so much of my idea, just skip it. I won't feel hurt, because I like the magazine anyhow.—D.P.L., Santa Paula, Calif.

Suggests Noisy Scarecrows To Give Crows the Bird

AMONG the letters in Our Readers Say, I noticed a complaint from O.O.M., of Louisville, Ky., asking for some device to protect rural power lines from the damage caused by crows sitting on the wires. I suggest that, at convenient intervals on the poles of the power lines, scarecrows be placed which can create a peculiar noise at intervals of one or two minutes. This can be done by making some arrangements in the scarecrows, such as sirens to be operated by power from the wires.—N.P., Benares, India.

Why Not Ask the Fish How They Feel About It?

IT SEEMS rather anomalous for me to write to America to refute the statement of a fellow Australian, but I consider it necessary to reply to C.F.P., of Auburn, Australia, when he says that he has "demonstrated by several tests that fish feel pain just as much as humans or animals do." I doubt if anybody is justified in making so sweeping a statement. Assuming that his loose classification of "humans and animals" includes only the higher vertebrates, I would inform him that fish have a rhinencephalon, a brain given over almost exclusively to the sense of smell; evidence points to the unlikelihood of their having any pain sense or receptors as we know them. As a medical student, I would point out that if he has the proofs he claims to have, he would do the neurologists a rare service in presenting them to the world.—J.H.D., Sydney, Australia.

Solves Mystery of Steam From Electric Locomotive

IN ANSWER to the query by J.E.T., of Cleveland, Ohio, with reference to the steam he saw issuing from the front end of a modern electric locomotive, I would like to offer the following: An engineer of one of the streamline electric locomotives of an eastern line explained it to me by saying that this steam was from the oil burner that it used to heat the cars in winter. If you look closely at one of these monsters, you will also see a pipe connection labeled "fuel oil." This startled me until I asked the reason for it.—C.W.V., Washington, D. C.

Want Simpler Ship Models Somewhere East of Suez

A NUMBER of us out here, subscribers to your magazine, were talking the other day about ship-model building and decided to write to you with a suggestion. Why not have Capt. E. Armitage McCann describe a large-scale model of a more simple type of ship than the full-rigged vessels he usually chooses? Something like a topsail schooner or a brigantine, for example. This would make less work to do and fewer details to describe, and more space could be devoted to showing exactly how the ropes ran, their uses, and where they were made fast. Details of deck fittings, methods of attaching yards to the mast, and other matters could be entered into more fully, so that even a landlubber could make a scale model worth having.—J R.C.D., Segamat, Malaya.

Here Is a Project That Speaks for Itself

I ENJOYED your articles on marionettes, and all that I have made have been very satisfactory. I now ask if you will publish an article on the construction of a ventriloquist's doll or dummy. I also second the motion of J.S., Albany, N. Y., for a monthly feature of "Popular Science Twenty Years Ago," presenting articles and illustrations from another day.—J.C., St. Lambert, Quebec, Canada.

He's Going To Raise His Boy To Be a Soldier—for Safety

I WAS reminded of your article on the underground fortresses of France, when I read in the newspapers of a similar defense line that has been built along the western frontier of Russia. It seems that, a short time ago, a couple of Russian armies were sent out to engage in maneuvers along this frontier. Both armies popped into the holes in the ground, and when they came out, a couple of weeks later, they had fought a whole theoretical war without ever catching sight of each other. That gives you an idea what the wars of the future will be like: the professional soldiers will hibernate in holes, while the airplanes settle the affair by working on the civilians. Believe me, I'm going to raise my boy to be a soldier. The Army's the only safe place in a war.—F.B., Terre Haute, Ind.

A Landowner Takes a Dig At Amateur Archæologists

I'D LIKE your magazine a lot better if you hadn't published that article about amateur explorers. On a piece of land that I own, a few miles outside this city, there is a little round hill that everybody takes for an Indian mound. Ever since I bought the property, I've been pestered to death by would-be archæologists, asking permission to dig into the hill. I have always refused, because I didn't want the place messed up, and I know there isn't anything in the mound, anyway. But now that you've gone and spread the idea that anybody can find a buried city in his back yard, I expect to be bothered more than ever. Think I'll sneak

out there some night and plant some calf bones and ten-cent-store pottery, and then take down the fence.—R.A.S., Louisville, Ky.

War Fever Grips The Model Makers

I HAVE been making your ship models and reading your magazine for some time, and think now is the time for you to lead the way for other magazines by being the first to give us models of historic arms and weapons of war. You could include historic rifles, pistols, swords, and armor, as well as artillery and siege machinery of all periods. I can't think of a more fascinating field for model making. And, say, how about putting out a construction kit for your Gettysburg model cannon, for those of us who can't afford turning tools? —J.T.T., Brooklyn, N. Y.

Some Welcome Corrections On "Junkman of the Air"

IN YOUR recent article "Junk Yard of the Air," the writer made a serious mistake. After mentioning the Gee-Bee's previous crashes, he states: "For the third time the ship was rebuilt, this time to take the life of Cecil Allen immediately after he had taken off from a southern California airport in an attempt to set a nonstop-flight record to New York." Had the author been acquainted with the construction of the plane, he would have known that it was equipped with only two ninety-gallon gas tanks, which would make a nonstop flight to New York impossible Furthermore, Allen was not after a nonstop record. He had entered the Bendix Trophy race to Cleveland, Ohio. As an eyewitness to the fueling of the ship, I feel qualified to speak.—D.K., San Bernardino, Calif.

Fate of "Heavy-Water" Drinker Preys on Reader's Mind

AWAY back in your April, 1935, issue, you published an item about Prof. Klaus Hansen, a Norwegian scientist, taking a chance by drinking "heavy water." Having felt no ill effects from his first sip, he was planning to drink more and more every day, to see what the result would be. Ever since I read that, I have been wondering what became of Professor Hansen. Can you give us some more information on the properties of "heavy water"? Another thing: one of your readers suggested an attachment for autos to burn the waste carbon monoxide. The trouble with that is that there would not be enough of a concentration of gas to burn. A more practical idea would be to use some catalyst to convert the carbon monoxide to carbon dioxide. —D.W.P., Sydney, Australia.

Says Man With Round Lake Should Hire a Surveyor

I CAN'T see the practical use of problems like the one about the road past the circular lake. I know of no perfectly round natural lake in the world. There might be an artificial lake of this kind in some privately owned estate, but in that case the owner has no right to have all us readers working away to solve a problem that concerns only him. I hope to see more problems in your magazine, but only practical ones.—E.B.L., Tocopilla, Chile.

Here's One To Try Out On Your Snow Shovel

NOT long ago, I went through my back issues and clipped out all the problems that have been published in Our Readers Say. Pasted in my scrapbook, together with letters written in comment on them, they make a nice collection of interesting problems and chatty letters. Now, here's a problem that fell into my hands recently and caused a lot of heated discussion among my friends. Read it carefully, and you will see how tricky it is: In a certain town, it began snowing before noon and continued at a constant rate all day. At noon, a crew of men set out to clear the highway, and cleared two miles of it in two hours. However, in the next two hours they cleared only one mile more, the amount of snow removed in this one mile being the same as that removed in the first two miles. In other words, it is assumed that the crew clears equal volumes of snow in equal times. The question is: at what time before noon did it begin to snow? Is there enough given in the problem to make a solution possible? You will notice that, in order for the men to remove equal volumes in equal times, they must slow up as they go along because the snow front keeps rising.—F.L.M., Aurora, Ill.

"Be Kind to Machines" Would Be His Slogan

H.J.B., of Seymour, Conn., is on the right track when he suggests a crusade for the prevention of cruelty to tools. But why not broaden the movement to protect the many electrical and mechanical appliances used about the home? Women are proverbially kind-hearted about children and animals, but they haven't any feeling for machines. For my part, it hurts me as much to see a good piece of machinery abused, as it does to see somebody beating a dog or a horse. Let's start a campaign to teach housewives how to treat appliances!—T.R.A., Brooklyn, N. Y.

A Would-Be Trapper Springs a New Idea

How about some dope on trapping? We've had articles on mining and similar subjects, but trapping—nix. Maybe the article could tell how to prepare skins for the raw-fur market. Perhaps you can find some old "mossback" who will pass on some tips on the art of trapping. Here's hoping to see something soon, as the season is getting on.—C.F.L., Kelowa, B. C., Canada.

Anybody Can Learn To Ski, If He Lives Long Enough

Now that winter is well on the way, how about an article on skiing? Up here where we have a bit of snow, it's just about getting to be a national sport. Why not publish a few pages of action photographs or drawings showing the amateur how to execute the simpler maneuvers without breaking his neck. The trouble is, the average novice doesn't live long enough to pick up the tricks by himself.—C.B., New Haven, Conn.

Maybe the Next Thing Will Be Synthetic Trees

PEOPLE like H.L., of Siloam Springs, Ark. are always taking the joy out of life. Giant vacuum cleaners for dead leaves would be swell as labor-savers, but one of the best parts about fall is the smell of burning leaves. Maybe R. H., of Tucson, Ariz., can come to the rescue with one of the synthetic woodland perfumes he wrote about in the last issue. Then all we'd have to do is sprinkle a little "Eau de Burning Leaves" on the lawn.—E.C.P., Cincinnati, Ohio

Sailor Finds Photography Is Gobs of Fun

IF A mere sailor can get in a couple of words, I'd like to vote an enthusiastic "Aye" to the letter of M.G., Brooklyn, N. Y. The more about photography the better. I suggest that you give us some plans on making a photoflash synchronizing arrangement for cameras with cable releases. It would be interesting from the standpoint that it would tax our ability as electricians, mechanics, and craftsmen, as well as in photography. I feel certain that most photo fans would appreciate equipment that would enable them to make action pictures at night at a minimum cost.—J.T.B., U. S. S. *Salt Lake City*.

How About the Gestures Of Political Orators?

WITH scientists all over the world trying to figure out ways and means to harness the sun and tides, it's a wonder some one hasn't come out with a plan for collecting all the wasted energy expended in gymnasiums and on dance floors. Some sort of a suspended floor should turn the trick. It could be arranged to pick up the impact from the athletes' and dancers' feet and drive an electric generator which, in turn, would charge storage batteries. Judging from some of the music I've heard and the dancing I've seen, the big problem will be to get a dynamo that will stand the load.—F.T., Toledo, Ohio.

This Will Start the Dolls Taking Screen Tests

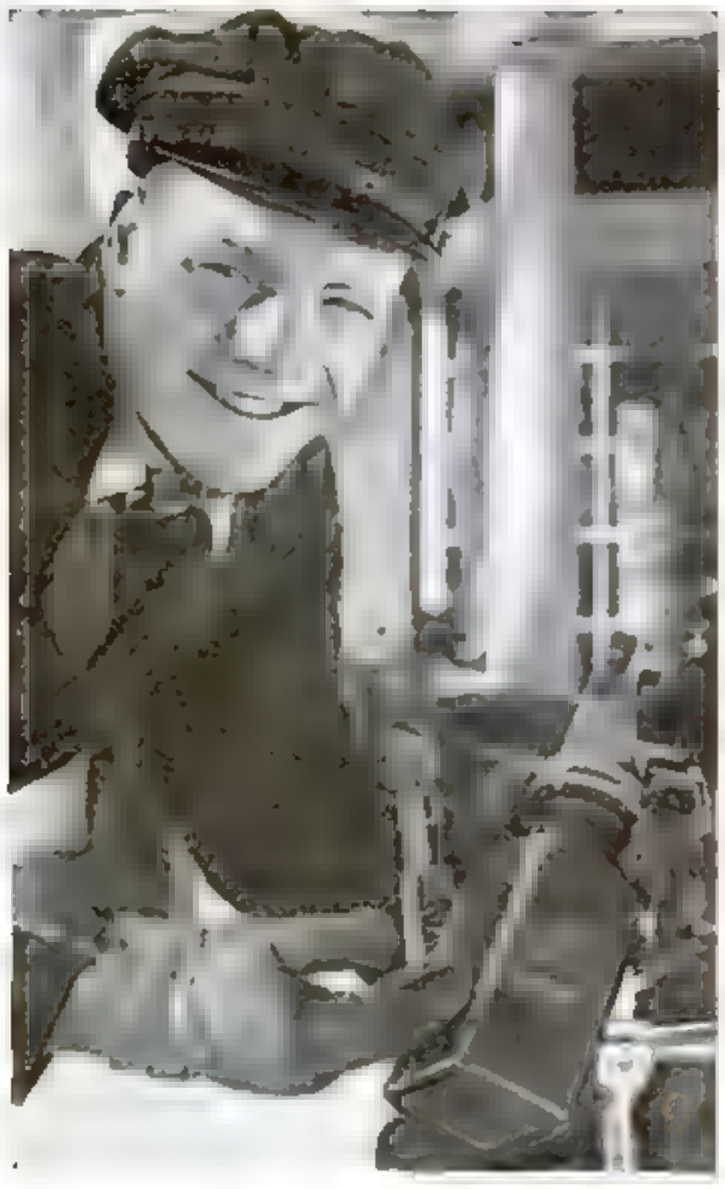
READING that fine article in the last issue describing the miniature stage settings now used in filming animated cartoons set me to thinking about my favorite problem again. Why is it that no one has attempted an animated movie using lifelike dolls, or marionettes, and midget settings. Instead of using drawings, the poses of the dolls could be altered for each frame or picture to give the illusion of motion. In certainly would be an interesting experiment for some home-movie fan who owns a good camera and a workshop. I believe that a somewhat similar stunt was used recently in a Russian movie which was exhibited in some of the larger cities in this country. In this case, though, the marionettes which made up practically all of the cast were manipulated with strings as in a marionette show.—W.H., Trenton, N. J.

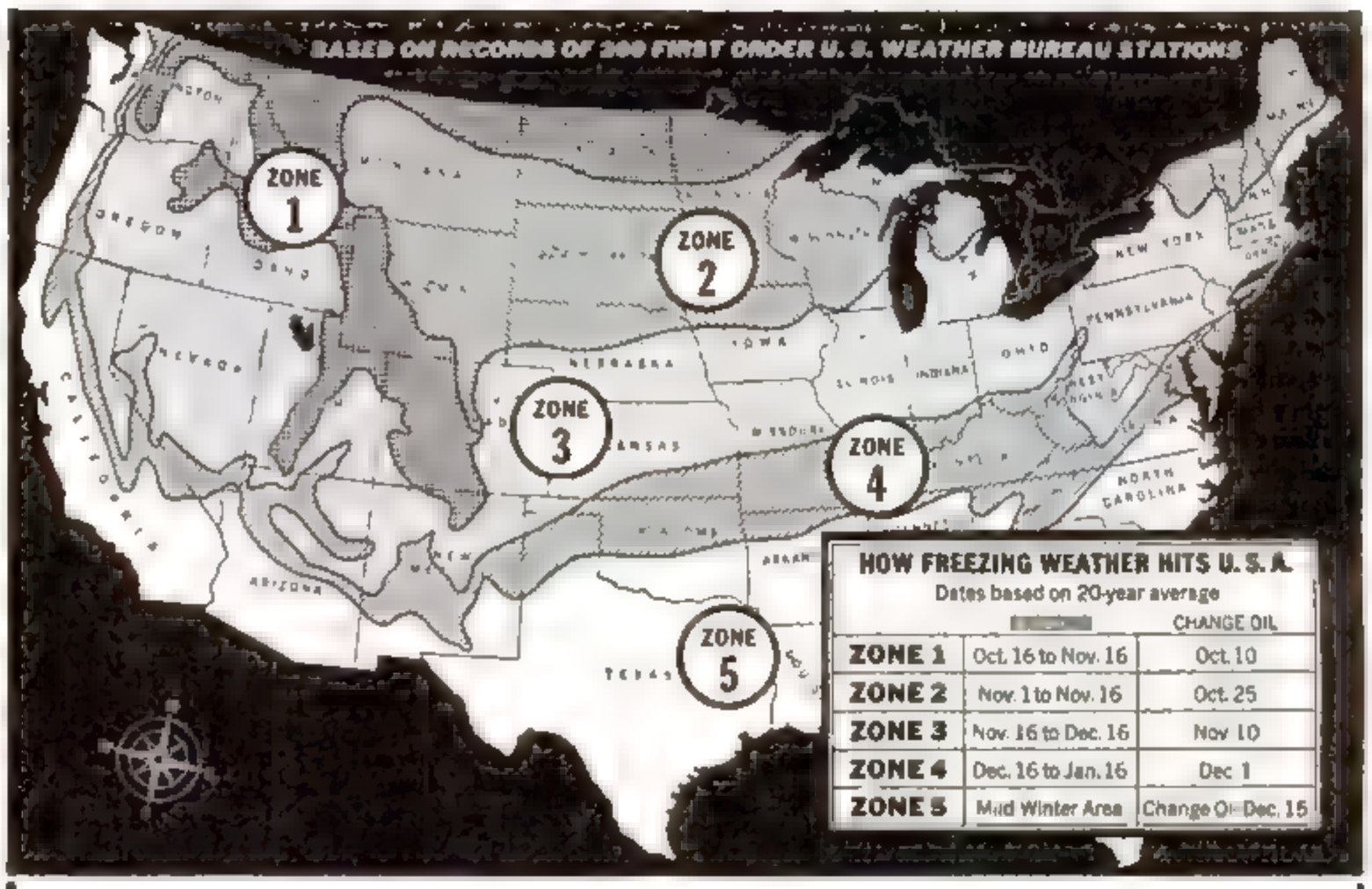
And a Mountain Climber Can't Sit on His Hands

I'VE been trying for a long time to find something wrong with your magazine, and now at last I have it. When I looked at the cover design of your October issue, it struck me that there was something screwy about the picture. Then I realized that if a person were climbing a mountain so high that it was necessary to use an oxygen mask, the temperature would be low enough that he would need gloves to keep his hands from freezing. How about it, now?—J.P., Saginaw, Mich.

MOBILOIL ARCTIC WINTER MAP

TELLS WHEN TO CHANGE OIL FOR A SAFE, QUICK-STARTING ENGINE!





HOW FREEZING WEATHER HITS U. S. A.
Dates based on 20-year average

		CHANGE OIL
ZONE 1	Oct. 16 to Nov. 16	Oct. 10
ZONE 2	Nov. 1 to Nov. 16	Oct. 25
ZONE 3	Nov. 16 to Dec. 16	Nov. 10
ZONE 4	Dec. 16 to Jan. 16	Dec. 1
ZONE 5	Mild Winter Area	Change Oil—Dec. 15

WARNING TO MOTORISTS Above freezing dates are *average*. Cold may strike much earlier. Change to Mobiloil Arctic at once . . . and—for safe, easy-shifting gears—get Mobiloil Winter Gear Oil.

WHEN winter strikes . . . be ready with the winter oil millions of motorists have proved through two of the hardest winters on record! Change *now* to clean, free-flowing Mobiloil Arctic made by the famous Socony-Vacuum Clearosol Process.

Mobiloil Arctic's double-range feature alone means money in your pocket. It's made to flow freely and lubricate perfectly at low starting temperatures . . . yet it's tough and full-bodied enough to stand up under high operating speeds and temperatures.

That's why you can change early to Mobiloil Arctic . . . avoid hard starting and dangerous wear . . . yet count on a safely-lubricated engine if mild spells return.

Make sure of quick starts and a safe engine—change now to Mobiloil Arctic! Where below-zero weather prevails—get Mobiloil Arctic Special, especially made for the most *extreme* cold weather.

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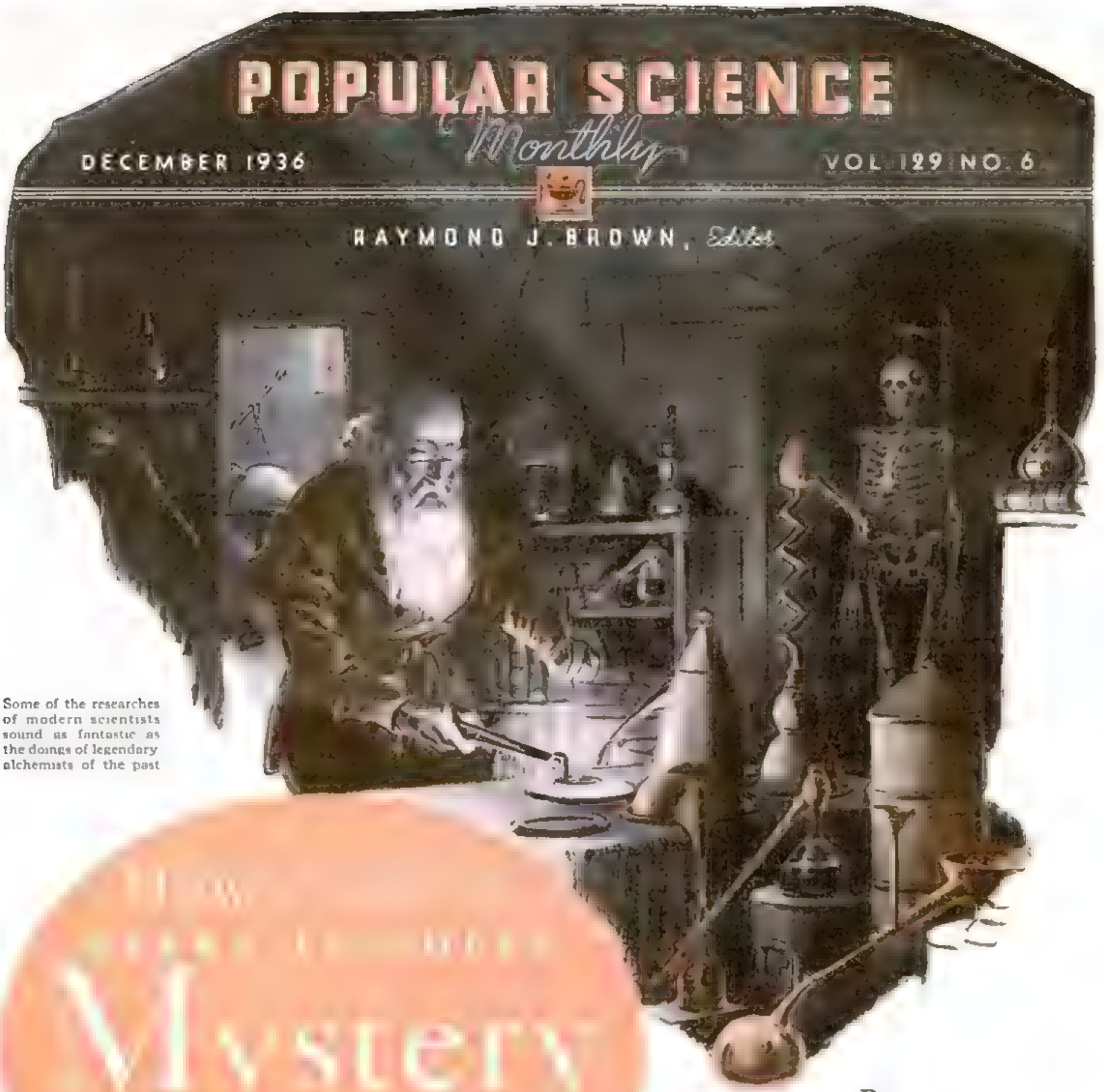
Shift Easy

Mobiloil Arctic AND MOBILOIL WINTER GEAR OIL

POPULAR SCIENCE Monthly

DECEMBER 1936 VOL 129 NO. 6

RAYMOND J. BROWN, Editor



Some of the researches of modern scientists sound as fantastic as the doings of legendary alchemists of the past

Mystery of Life

By

EDWIN TEALE

SKIRTING the borders of science's greatest mystery—the riddle of life itself—research workers in a dozen laboratories have achieved sensational progress in recent months. With synthetic blood, test-tube protoplasm, intricate mechanisms of glass, they have pushed back the frontiers of biological knowledge. Their achievements stir the imagination and hint at amazing things to come.

Two University of Oregon scientists, Dr. Edwin E. Osgood and Alfred N. Muscovitz, are working with a labyrinth of glass tubes, jars, bulbs, and membranes. Their apparatus is an artificial bone for creating blood cells in the laboratory. In it, for the first time in history, the red cells have been produced outside of animal bodies.

By a delicate operation, the men obtain a syringeful of marrow from a breast bone. This living matter is transferred to a jellylike substance in a tube of the apparatus. While a mixture of gases flows through the tube, which is kept at a constant temperature, a special membrane permits nourishment to enter and waste products to diffuse out. Thus, the marrow lives under natural conditions. It grows, kills germs, produces new blood cells, all within its transparent housing.

This astonishing "glass bone" is but one of many innovations which enable the modern scientist to watch life processes in the laboratory. Some of these set-ups are so involved that it takes a week to prepare for an experiment which lasts but fifteen minutes. Such is the case at Brown University, Providence, R. I., where Dr. J. Walter Wilson is probing the secrets of animal life.

In one recent test, Dr. Wilson peered through a powerful microscope at the cells of a rabbit's kidney which he kept alive for hours by means of a flow of synthetic blood consisting of a salt solution, oxygen, and the red corpuscles from beef blood. What

RABBITS WITHOUT FATHERS

Dr. Gregory Pincus, of Harvard University, and some of the equipment he uses in fertilizing the egg of a rabbit by chemical means. At right, a microscopic camera trained on egg in incubator

he saw strengthened the theory that individual cells breathe. By heating the kidney, he discovered that the rate of oxidation increases as the temperature rises. When he added poisonous cyanide to the synthetic blood stream, he saw minute crystal-like rods within the cells shatter as the kidney died.

In the summer of 1935, an announcement from Rockefeller Institute, in New York City, spurred on the age-old search for the secret of life.

It stated that a mechanical riddle which had baffled inventors for more than a century had been solved. Col. Charles A. Lindbergh, working in collaboration with Dr. Alexis Carrel, America's first winner of the Nobel Prize in medicine, had designed a mechanical heart which pumped synthetic blood with the same pulsating flow that characterizes the human life stream.

This invention opened up a whole new field of research.

Individual organs—livers, lungs, kidneys, glands—can now be kept alive indefinitely and can be studied through the transparent walls of their containers. Thus, investigators can watch the progress of disease and can study the effect of diet and drugs upon the individual organ. They have a new approach to the problems of life and death.

In one instance, Rockefeller Institute scientists attached a thyroid gland to the Lindbergh heart. The cells of the gland grew; its arteries pulsed; its secretions continued to flow for weeks after the cat from which it came had been buried.

Even more amazing is the report of "eggs laid in a test tube." Supplied with synthetic blood, the ovaries of a chicken continued to function, just as the thyroid gland had done, and actually produced several rudimentary eggs!

A by-product of investigation by means of this new technique is a clearer understanding of how to treat heart afflictions. In St. Louis, Mo., Dr. William B. Kountz, of the Washington University School of Medicine, has been conducting researches that sound like the doings of some ancient alchemist. He is bringing dead hearts to life in the laboratory and then studying the effect of various drugs upon the diseased organs.

Thus, in various parts of the country, research scientists have developed apparatus which imitates life or keeps life going. But, they have not created life. Beyond their work lie the frontiers of the unknown.

Two centuries ago, the inventor of the compound microscope, Anton van Leeuvenhoek, took from a mud puddle some minute animals, called rotifers. He laid them away in his laboratory where they remained for five months, as dry as dust. By every test Leeuvenhoek could make, they were dead. But when he dropped them in water, they wriggled and revived. Later on, another experimenter dried out a handful of nematodes, a species of tiny worm. Although the average life span of such creatures is only ten months, these revived at the end of twenty-eight years when placed in water. In medical history, there are cases where hearts have started to beat eighteen hours after doctors have signed death certificates.

What is the dividing line between life and death? What is the mysterious something we call life? What is gone when a cell is dead? Five thousand years of study have failed to give the answers.

If you coat the end of a fine glass rod with shellac and then place the rod in a drop of chloroform, the drop will suck in the rod, dissolve off the shellac, and expel the glass. It behaves exactly as an amœba does when it devours another amœba and expels the waste material. Yet, the amœba is alive; the chloroform is not.

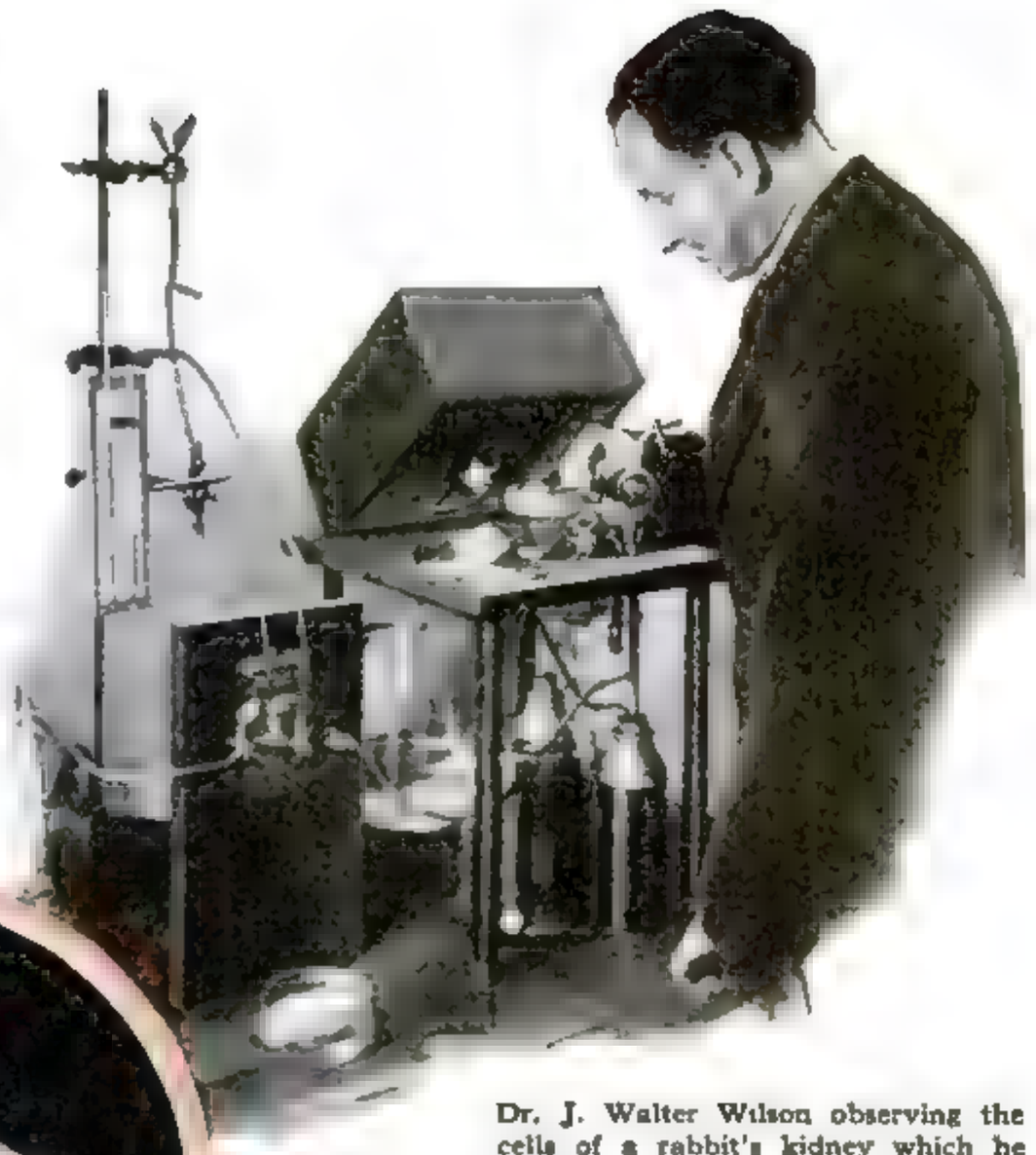
Again, if you touch opposite sides of a drop of oil with small pieces of sodium carbonate, the surface tension is so changed that the drop splits neatly into two drops, just as an amœba does when it reproduces itself. The oil acts like a living thing, but it does not possess life. What does it lack?

One thing it lacks is a translucent, jelly-like fluid called protoplasm. This stuff of life is found in the cells of every plant or animal that lives. Chemists can give you the exact formula for it: Oxygen 72 percent; carbon 13.5 percent; hydrogen 9.1 percent; nitrogen 2.5 percent. In addition, there are traces of iron, silicon, manganese, magnesium, calcium, chlorine, phos-

Chemistry Duplicates "Life Wall" of Cells

AS THIS issue goes to press, Dr. Irving Langmuir, Nobel Prize winner in chemistry and recipient in 1932 of the $10,000 Popular Science Monthly Award for notable scientific achievement, announces another step toward the solution of the mystery of life—the creation in the laboratory of a substance behaving like the wall which surrounds the living cells of men and animals. As a result of this discovery, it is said, experimenters can produce artificial cell walls a foot square, making it possible for the first time to study in detail properties which would be difficult to measure on tiny living cells.

With Amazing Apparatus That Imitates Life, Or Keeps Life Going in Individual Organs, Research Workers Study Secrets of Growth



Dr. J. Walter Wilson observing the cells of a rabbit's kidney which he kept functioning with man-made blood

phorus, sulphur, fluorine, sodium, and iodine. That is all. But if you stir these ingredients together, what do you get? A blob of worthless mud. Something is lacking. It is this something beyond the chemical aspects of living matter, that eludes the research worker.

Aristotle, the wisest man of his time in Greece, thought life sprang from the soil. Even in comparatively recent times, scientists believed that life was generated in mud and rotting wood. Today, we know that this is not true. Dr. George Washington Crile, noted Cleveland, Ohio, surgeon, advances the theory that electricity explains the spark of life in the cell; that our bodies are composed of billions of tiny dynamos. All scientists, of course, do not subscribe to this opinion. But they are positive of one unchanging law. It is: "Life comes only from life; protoplasm is created only by protoplasm."

As an aid to studying this stuff of life, Dr. William G. Camp, of Columbia University, New York City, has devised a new method of growing virtually pure protoplasm on a diet of oatmeal and water. He places a folded filter paper on a shallow dish, sets it in a wide-mouthed jar containing water, and then plants a bit of inactive slime mold on the paper.

This material, on the borderline between plant and animal life, is almost pure protoplasm. On the damp paper, it begins to grow and creep about. Dr. Camp then sprinkles it with oatmeal, which it engulfs and consumes. Growing steadily, the living jelly soon forms thick sheets which can be removed for experimentation.

Encased within membrane walls, hardly 1/250 inch thick, protoplasm forms the cells, the building bricks of living matter. All roads of biological research lead to the cells. Within them, science is sure, lies the answer to the mystery of life.

In recent years, laboratory workers, journeying into the invisible, have learned many things about the cells. They have watched the tiny units dividing like amœbas. They have studied the strange strings and clumps of chromosomes, the threadlike bodies which hold the genes—elements in the cell which pass on hereditary characteristics. They have discovered that a single chromosome may hold thousands of genes hardly larger than molecules.

If you stretched out an inch until it reached from coast to coast, 3,000 miles, and expanded a gene accordingly, it would cover less than 100 feet! Yet these infinitesimal factors in the reproducing cells determine whether a flower shall be red or blue; whether a man shall be dark or fair.

Only a few months ago, Barbara McClintock, a research worker at Cornell University, Ithaca, N. Y., reported an important discovery. Barely visible dots in the protoplasm, she found, act as "generators" in the production of chromosomes when the cell divides. In more recent tests, she has succeeded in photographing the dots. They are formed, she believes, of some unknown combination of chemicals.

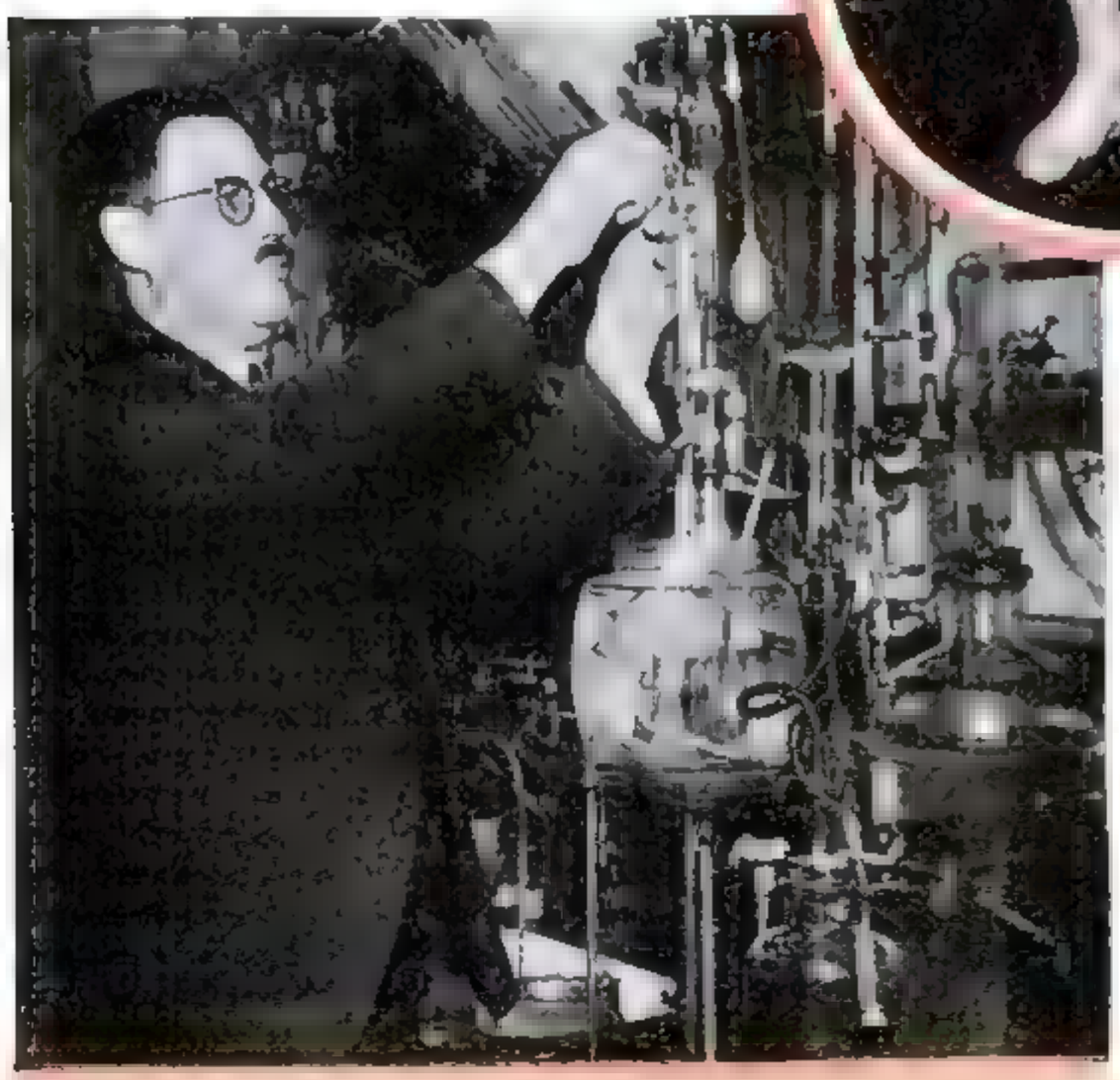
Rabbits born without fathers. That is the possibility foreseen through another experiment with living cells. At Harvard University, Cambridge, Mass., Dr. Gregory Pincus has been working toward this feat of apparent magic.

During a number of experiments, he has removed an egg from a female rabbit, fertilized it by the use of chemicals, and transplanted it in another mother rabbit where it developed into an embryo. In some instances, the fertilization was accomplished simply by heating the eggs to a temperature of 113 degrees F.

Going even farther than Dr. Pincus, another worker, at the U. S. biological laboratory at Woods Hole, Mass., has produced animal life without either father or mother!

Whirling unfertilized eggs of the common sea urchin in a centrifuge developing a force equal to 10,000 times the pull of gravity, Dr. Ethel Browne Harvey split the eggs in half. Then she sorted out the pieces which contained no nuclei, or mother elements, and fertilized them chemically. Placed in sea water, these egg fragments developed into creatures, living and moving, which had neither fathers nor mothers.

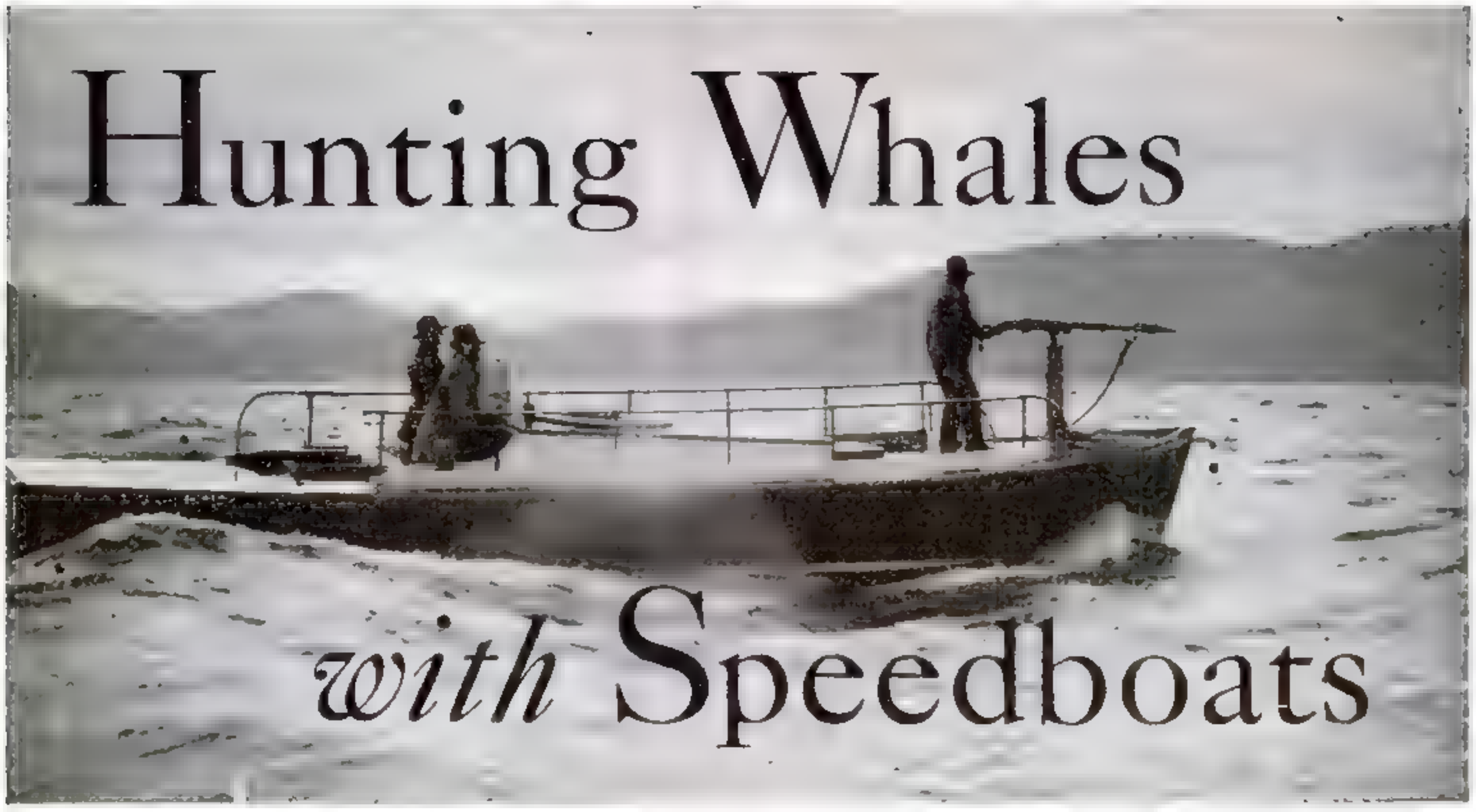
Some of the most amazing work being done in the study of life and its processes is that accomplished in connection with sex and reproduction, with life's beginning. *(Continued on page 127)*



By actual tests on living organs, modern scientists are learning more about the part played by blood in our vital processes

Here a syringeful of marrow is being placed in a tube where it will live, grow, and produce new blood cells in view of the experimenters

Hunting Whales *with* Speedboats



New Zealand whalers hot on the trail of a humpback in Cook Strait. This is one of the three 300-horsepower racing craft armed with harpoon guns

By **ROBERT E. MARTIN**

FORTY-MILE-AN-HOUR speedboats are now hunting the biggest game in the world. Powered with aircraft engines and directed by short-wave radio, they have just brought in an all-time record haul of humpback whales in Cook Strait, the slim stretch of water that splits New Zealand in two.

Through this channel, each year, the migrating ocean monsters travel north from antarctic seas. Here, J. Perano, a veteran of the region, recently introduced a thrilling, split-second innovation in the ancient art of whaling.

Three hundred feet up on a mountain side overlooking the water, he has established a radio station and observation post. With high-powered binoculars, he and his assistants scan the water, searching for telltale fountains of spray which show where whales have come to the surface to breathe. The instant one is sighted, short-wave radio flashes its location to three pursuit boats, *Cachalot*, *Miss Whekenui*, and *Sea Raider*, anchored below the cliffs. With engines roaring, they begin the chase.

These 300-horsepower boats are modified racing craft combining speed with stanchness. Except for low railings and the slim, deadly harpoon cannons mounted at the bows, the decks of the gray boats are kept cleared for action. The whale spouts again, half a mile ahead. Every ten or fifteen minutes, it must come to the surface for air. Sooner or later, the swift little boats will be close enough to strike.

With feet wide apart on the lurching deck, the harpooner inserts a flat, brass cartridge filled with blasting powder in the breech of the cannon, and then rams the heavy shaft of the harpoon into the muzzle. The sharp, triangular head of this spear is packed with explosives which are fired by a time fuse eight seconds after the missile leaves the gun. To prevent the spear from tearing loose after it has struck the whale, there are three six-inch barbs hinged to the shaft just behind the head. The range of the harpoon cannon is about sixty feet.

Again the leviathan spouts, this time close on the right. The boat wheels like a terrier and rushes for the quarry. In a cloud of spray, the gunner rides erect, tense and waiting. A vast black body, wet and shining, with a curiously knobbed and warty head, rises above the water. The boat cuts close; the gunner swings the swiveled cannon to one side, and—boom! —the harpoon, with a flying tail of uncoiling rope, drives deep into the flank of the monster. Water showers over the boat as the whale dives. But the detonating head of the harpoon soon sends it to the surface again.

This time, the harpooner is ready with an electrical spear, a deadly combination of lance and bomb. He drives home this weapon and the whale again disappears, trailing behind it a thread of insulated wires. On the boat, the helmsman touches the end of the wires to electrical connections. There is a muffled roar and the sea monster rises in its death struggles, the water red with blood. Quickly, the little boat maneuvers alongside and the harpooner hurls his final dart, a hollow spear through which air is pumped by the engine into the giant carcass to insure that it will stay afloat.

The quarry is sighted. The lumbering leviathan is no match for the fast-moving little boats

DIRECTED BY SHORT-WAVE RADIO FROM A LOOKOUT HIGH ON A MOUNTAIN SIDE, NEW ZEALAND WHALERS USE TINY RACING CRAFT TO DOG HUGE LEVIATHANS AS THEY PASS THROUGH A BOTTLE-NECK OF THE SEA

The lookout in his post high up on a hill above the strait. When he sights a whale, he flashes its location to the speedboats anchored near the base seen at the left

This nerve-tingling battle, in which science plays a leading role, may be over in a few minutes. With water lapping against it, the huge body of the whale floats on the surface waiting for the tender, the *Tuatea,* to reach the spot and tow the carcass back to the factory where the oil is rendered from the blubber.

Here, too, modern machinery and methods have speeded up the work. Steam-driven winches haul the forty-ton whale onto a slip where workers strip off great ten-foot-wide blankets of blubber. These are then chopped into smaller squares and fed to a high-speed mincing machine. Its whirling blades can shred blubber as fast as two men can feed it. In sixty minutes it can slice up the fatty material of a whole whale.

Even the head and bones of the monster are now rendered to obtain additional oil. Special boilers with a steam pressure as high as eighty pounds to the square inch extract it. So efficient are these modern methods that fourteen tons of oil are obtained from a forty-ton whale.

The best grades of the oil are used for making soap, lubricants, and margarins. Other grades are employed in dressing leather and various vegetable fibers. The poorest types, coming from the head and bones, find a place in bitumen mixtures for waterproofing and sealing pavements.

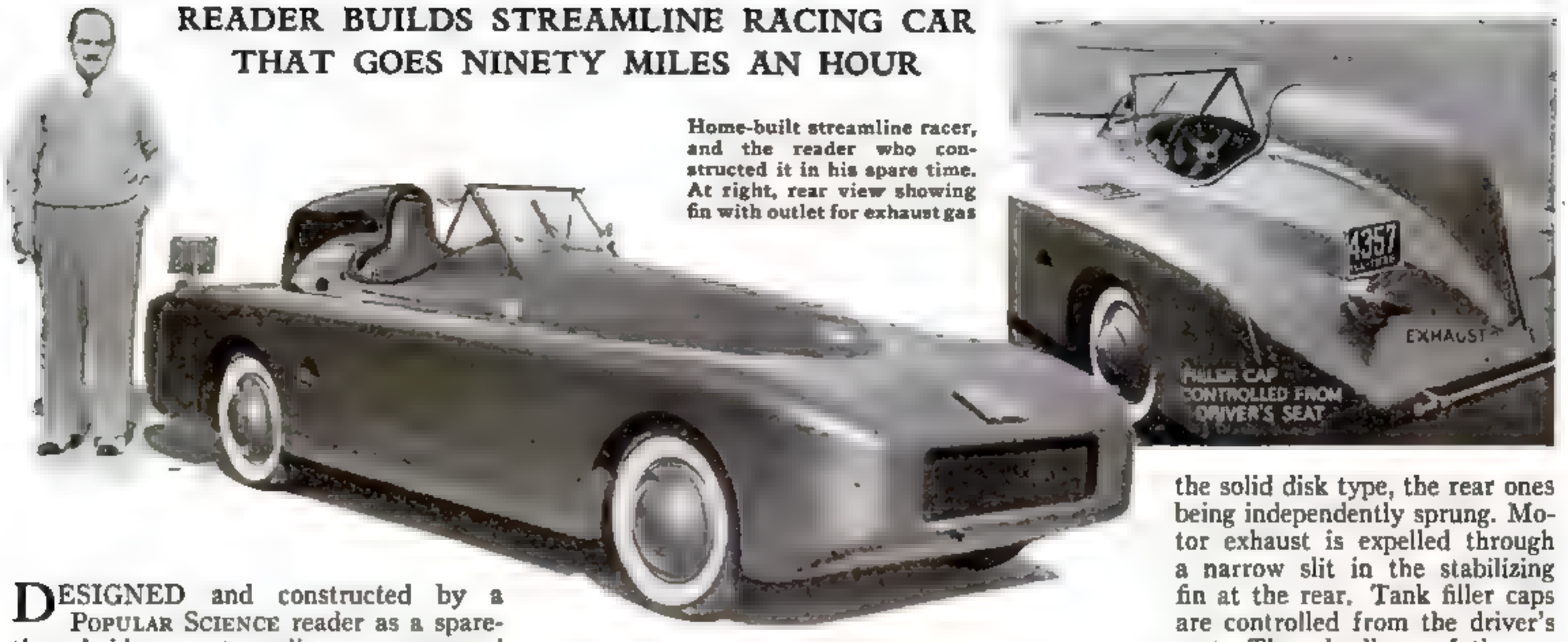
Practically all the whales killed in Cook Strait are humpbacks, for the right, or Balan, whales are protected by international agreement, and other species are rarely seen. Though many of the migrating humpbacks escape the spears of the whaling fleet by passing through the channel at night, the whalers set out every morning at sunrise, and speed northward in the hope of catching any that may have passed the shore base in the darkness of the early hours just before dawn.

Sometimes, in the course of a chase, the whalers will come upon two whales together. If they happen to be a male and a female, the latter is selected for the first kill. This is because of the curious fact that a male whale will stand by a stricken mate, and so may be harpooned later. If the male is attacked first, however, the female will make off at once and be lost.

Previously, a catch of a half dozen humpback whales in Cook Strait during the season of June, July, and August was considered a peak performance. Now, through Perano's application of speedboats and radio, the record has risen 1,000 percent. This year, his harpooners, with their electrical spears and time-fuse bombs, have brought in a grand total of seventy whales. As many as eight of these monsters have been towed in from the strait by this miniature fleet in the course of a single day.

Poised on the lurching bow, the harpooner fires his deadly, explosive shaft into the monster's flank

READER BUILDS STREAMLINE RACING CAR THAT GOES NINETY MILES AN HOUR



Home-built streamline racer, and the reader who constructed it in his spare time. At right, rear view showing fin with outlet for exhaust gas

DESIGNED and constructed by a POPULAR SCIENCE reader as a spare-time hobby, a streamline, square-nosed racing car has many novel features. Completed after three years' work, the car is powered by an eight-cylinder, V-type motor geared to the front wheels. Hood latches, locks, and retractable headlights are concealed within the car body, which also houses baggage, tools, radio, and a spare wheel and tire. All wheels are of the solid disk type, the rear ones being independently sprung. Motor exhaust is expelled through a narrow slit in the stabilizing fin at the rear. Tank filler caps are controlled from the driver's seat. The wheelbase of the car is eighty-six inches and its total weight is 1,500 pounds. The speedster is said to go ninety miles an hour and to run thirty miles on one gallon of gas.

CHEMICAL WIPER IS REFILLABLE

Chemical refill being placed in wiper blade for use against sleet

CAR windshields are cleared of sleet by a refillable chemical wiper just marketed. Snapped on in place of the regular wiper blade in a few seconds, the new device has a steel frame which unlocks to admit fresh chemical refills when necessary. Packed in a handy box containing extra refill elements, the wiper is easily tucked away in the car pocket for use when needed.

SPRAY IS SPEEDY SUN-TAN REMOVER

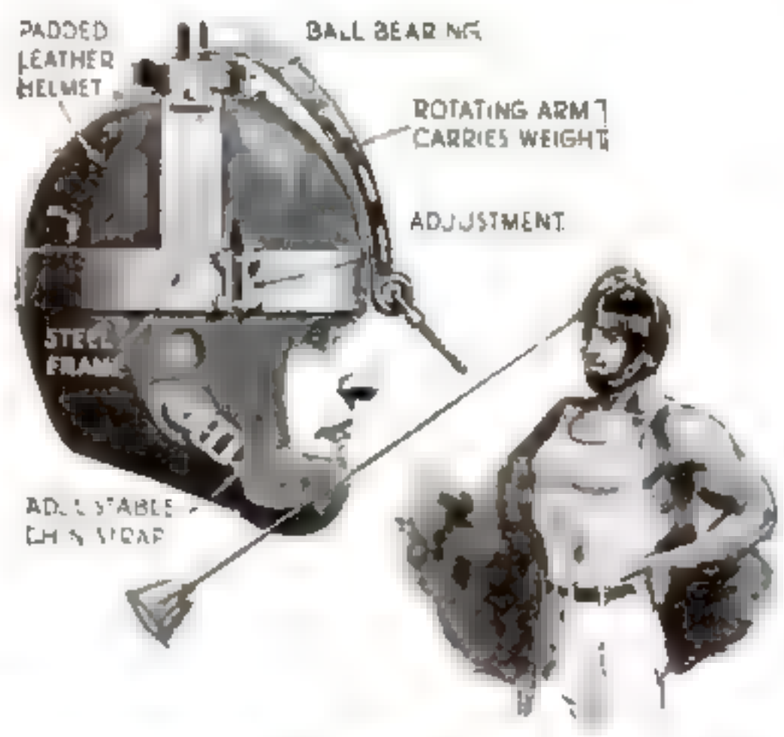
PERSONS who want to lose a coat of sun tan can have it quickly removed from their skin by a new method demonstrated at a recent English exhibition of cosmetics. Applied over the skin with a spray gun, a white chemical liquid covers the tanned surface and forms a temporary dry coating. The chemical treatment, it is said, bleaches the tan and returns the skin to its natural shade.

A special preparation sprayed on the skin bleaches it to natural shade

PLANE TAKES OFF FROM RAILWAY CAR

PLANES may soon take off from flat cars running on railroad tracks. In a recent experiment conducted by a California test pilot, a biplane resting on a small flat car raced along a section of track under its own power, and took off at seventy-five miles an hour after a short run. Starting from rails rather than from the ground, it is believed that heavy loaded planes can take off with shorter runs.

The plane leaving the small flat car on which it gathered enough speed for the take-off

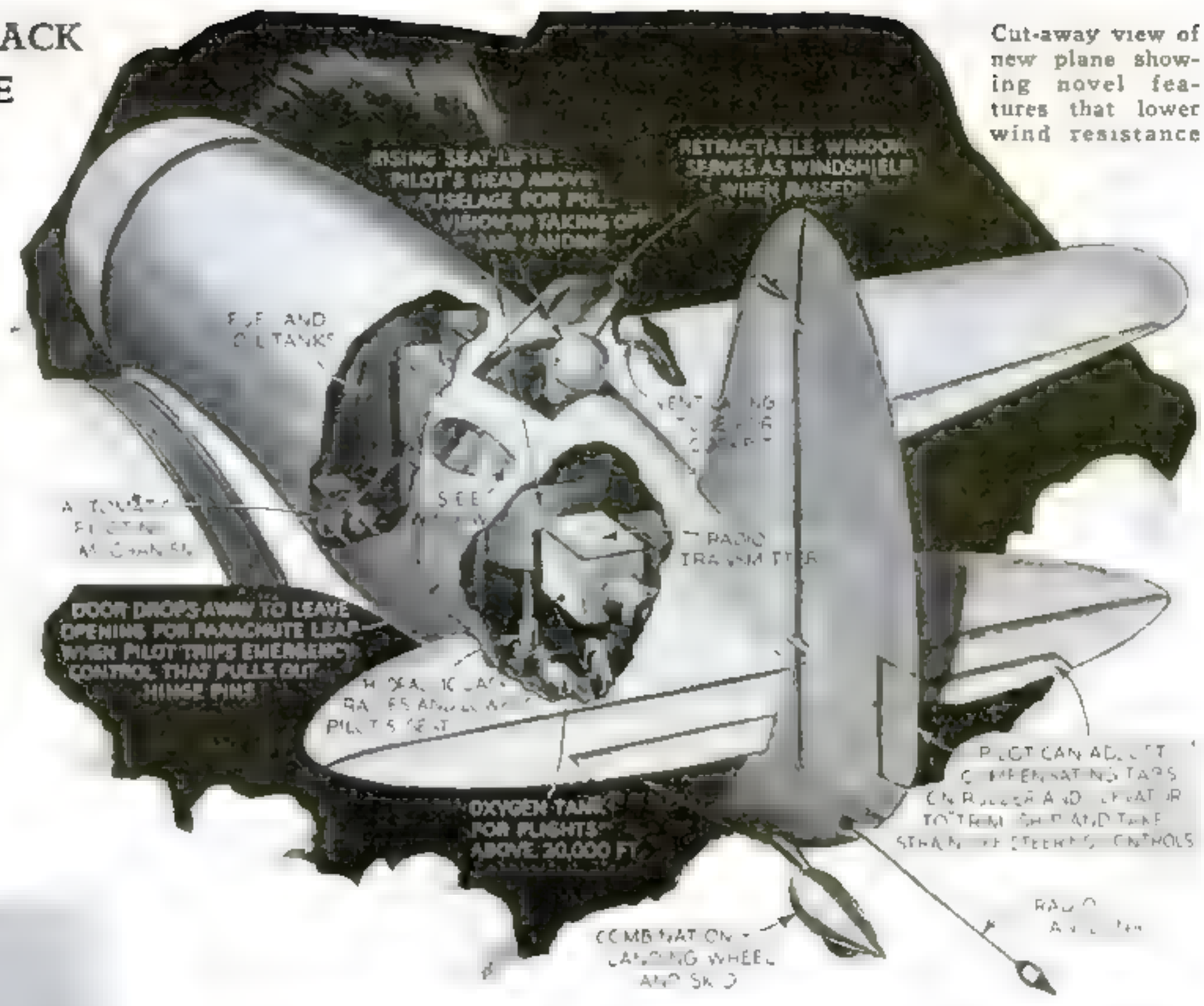


EXERCISES NECK MUSCLES

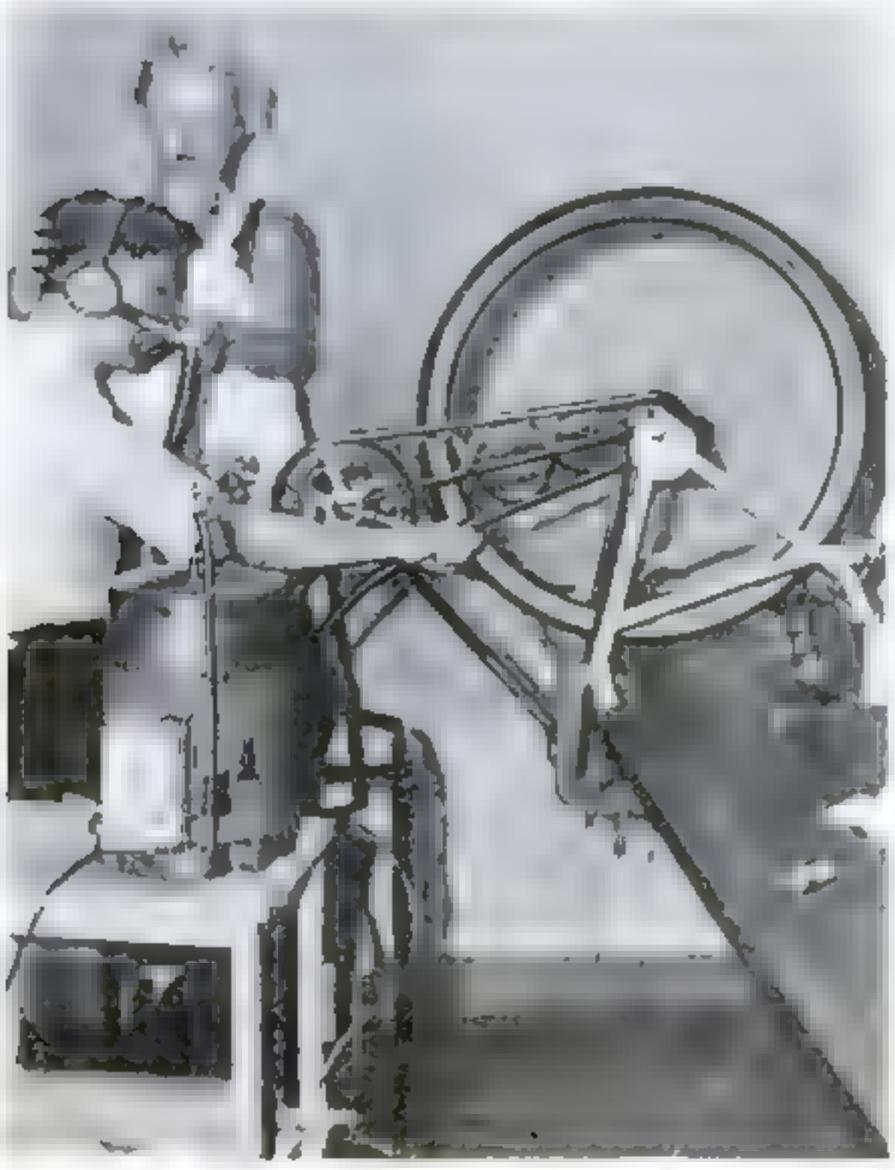
NECK and shoulder muscles are said to be strengthened by an odd, new exercising device. Supported by a metal frame attached to a padded helmet, a weighted cable swings around the exerciser as he rotates his head. The revolving weight thus creates a tension that is said to flex and strengthen the muscles in the neck and upper part of the body and also to improve the posture.

PILOT LIFTS HIMSELF ON JACK IN LATEST SPEED PLANE

BUILT to reach a top speed of 375 miles an hour, a new speed plane developed by Frank Hawks, noted racing pilot, embodies features new to modern airplane design. Radically streamline, so that not even a windshield projects from the fuselage, the plane has a completely inclosed central cockpit with small side windows and a hinged roof of safety glass. When wide visibility is needed for a take-off or landing, the pilot operates a hydraulic jack mechanism which raises his seat and slants the hinged roof upward to form a windshield. In the air, the seat and windshield drop back into normal position. An aluminum tube carries fresh air from the leading edge of a wing into the inclosed cabin. Driven by a 1,150 horsepower engine, the speed plane is equipped with retractable landing gear and lights, an automatic pilot mechanism, and two-way radio apparatus.



Cut-away view of new plane showing novel features that lower wind resistance



ODD TEST MEASURES RESISTANCE TO COMMON WINTER COLDS

How many colds a person will have during the winter can be predicted by a new method that tests an individual's ability to absorb oxygen during exercise. Wearing an oxygen mask, the subject hand-pedals a stationary bicycle, while research workers measure the amount of oxygen consumed for each square meter of body surface. The greater the amount a person consumes, the higher his "fitness rating." Tests of 100 volunteers showed their resistance to colds approximated this rating.

EYES REVEAL MANY DISEASES

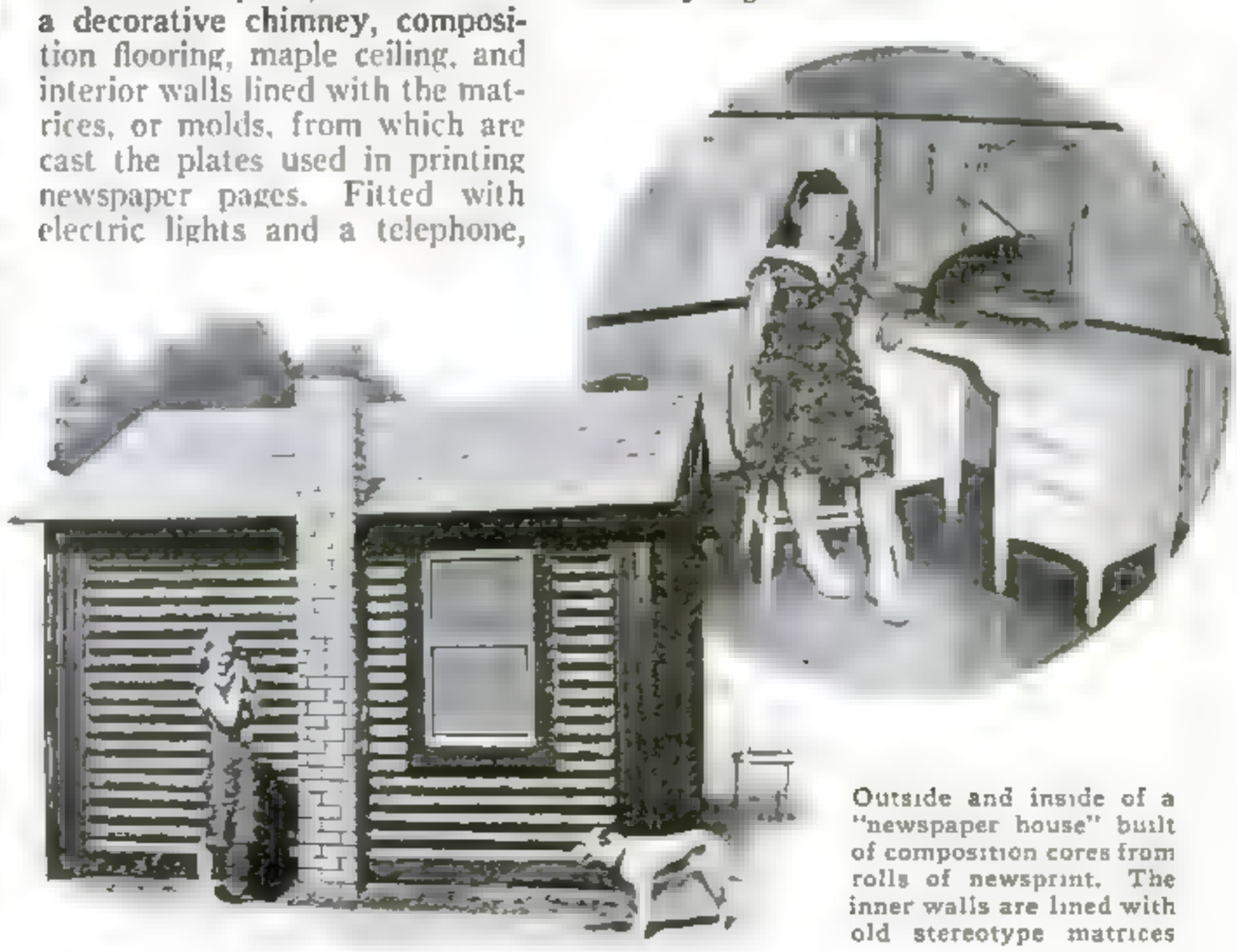
HIGH blood pressure, brain tumors, and many similar ailments now can be detected by studying photographs of the patient's eyes, according to Dr. Arthur Bedell of Albany, N. Y., who has been experimenting with the process. Snapshots of the retina made with a special camera show the network of veins, whose structure reveals the disease and is the means of following its progress.

LIGHTNING CARVES HAND FROM KNOT IN TREE

LIGHTNING striking a hickory tree in the Great Smoky Mountains of North Carolina shaped a knotty piece of wood into a form closely resembling the hand of a child. Discovered by a sportsman while on a hunting trip, the knot was cut from the tree and the "wrist" trimmed with a penknife. In the illustration at the right, the strange phenomenon is shown in comparison with a human hand. Even the fingernails and tendons of the hand are represented.

"LOG CABIN" BUILT OF CORES FROM NEWSPRINT

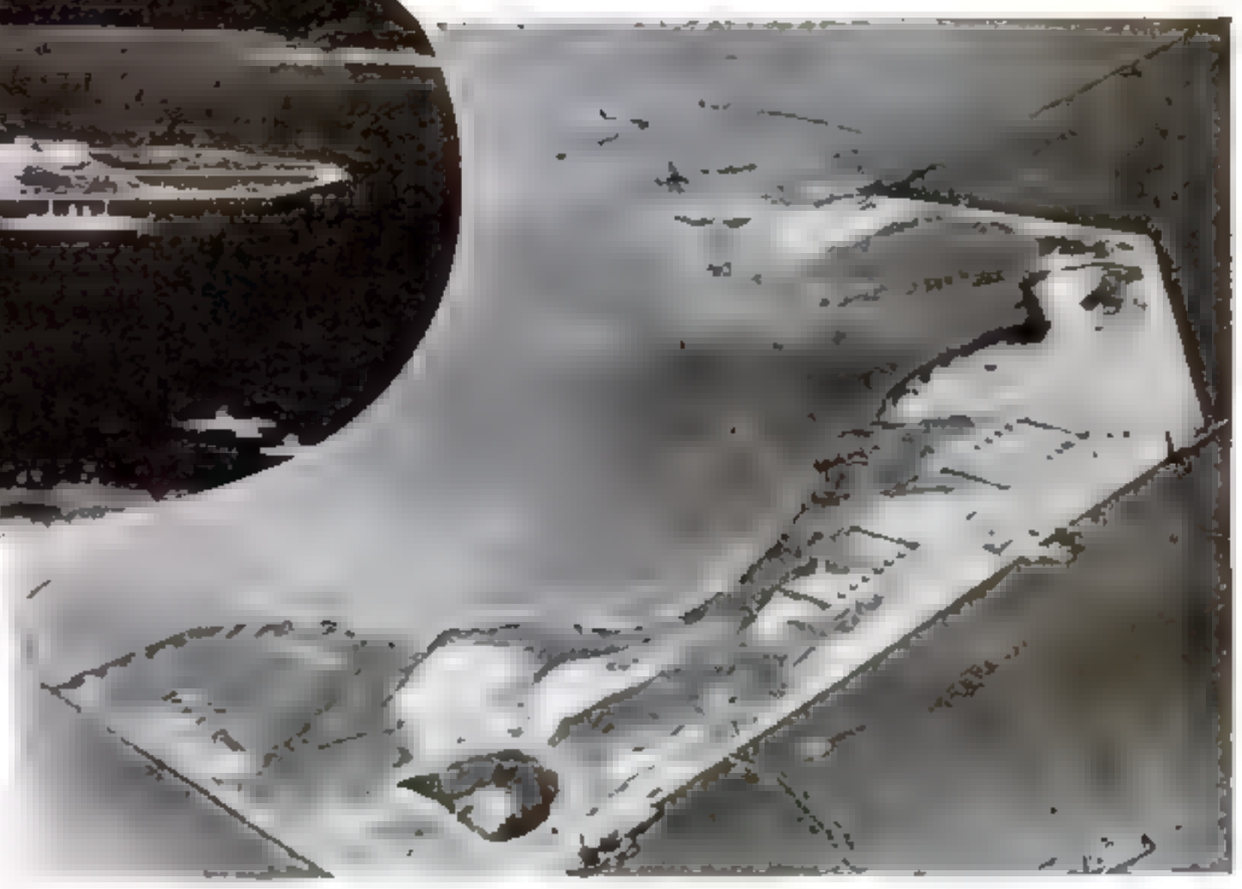
CORES from large rolls of printing paper form the outside walls of a novel "log cabin" built by a Texas publisher. About eleven feet square, the house has a decorative chimney, composition flooring, maple ceiling, and interior walls lined with the matrices, or molds, from which are cast the plates used in printing newspaper pages. Fitted with electric lights and a telephone, the one-room cabin cost about $250 to build. The cores used for the walls are made of wood pulp and glue, and it is believed that they will last as long as ordinary logs of wood.



Outside and inside of a "newspaper house" built of composition cores from rolls of newsprint. The inner walls are lined with old stereotype matrices

ARTIFICIAL ISLAND IS BUILT AS SITE FOR EXPOSITION

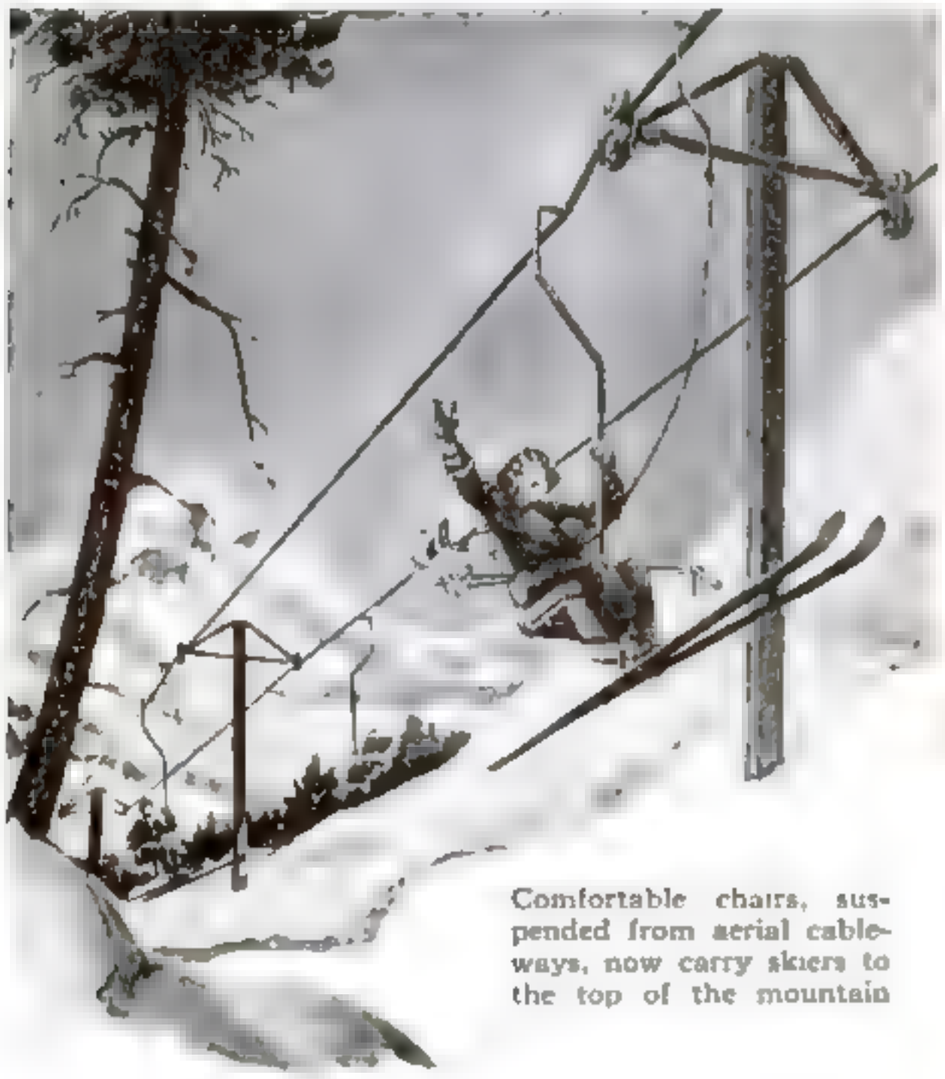
How the new exposition grounds will appear in San Francisco Bay



Airplane view of the filling operations that are creating a 400-acre island

NEARLY half completed, a 400-acre man-made island is rising from the waters of San Francisco Bay, where dredges are pouring 3,000,000 cubic yards of sand a month into a U-shaped sea wall to create a site for the Golden Gate International Exposition of 1939. A six-lane motor highway will join it to Yerba Buena Island and the San Francisco–Oakland Bay Bridge.

SKIERS RIDE ELEVATOR UPHILL

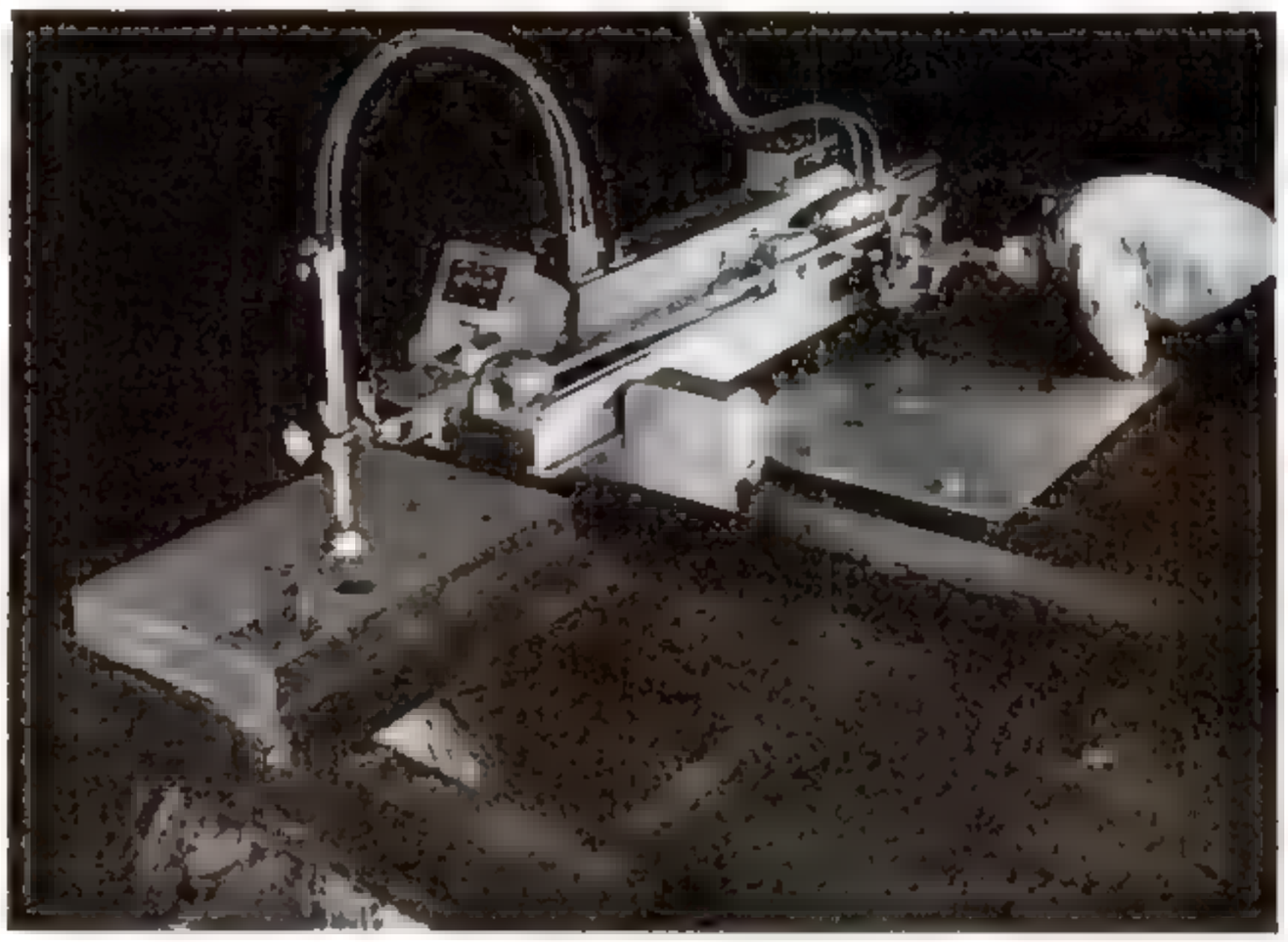


Comfortable chairs, suspended from aerial cableways, now carry skiers to the top of the mountain

SWINGING in comfortable chairs, skiers will be whisked to mountain tops by cableways under construction at Ketchum, Idaho. First of their kind, the elevators are a refinement of "ski tows" used elswhere, in which the passenger grasps a moving handle or leans against a support and rides on his own skis. The longest of the new lifts is 3,490 feet.

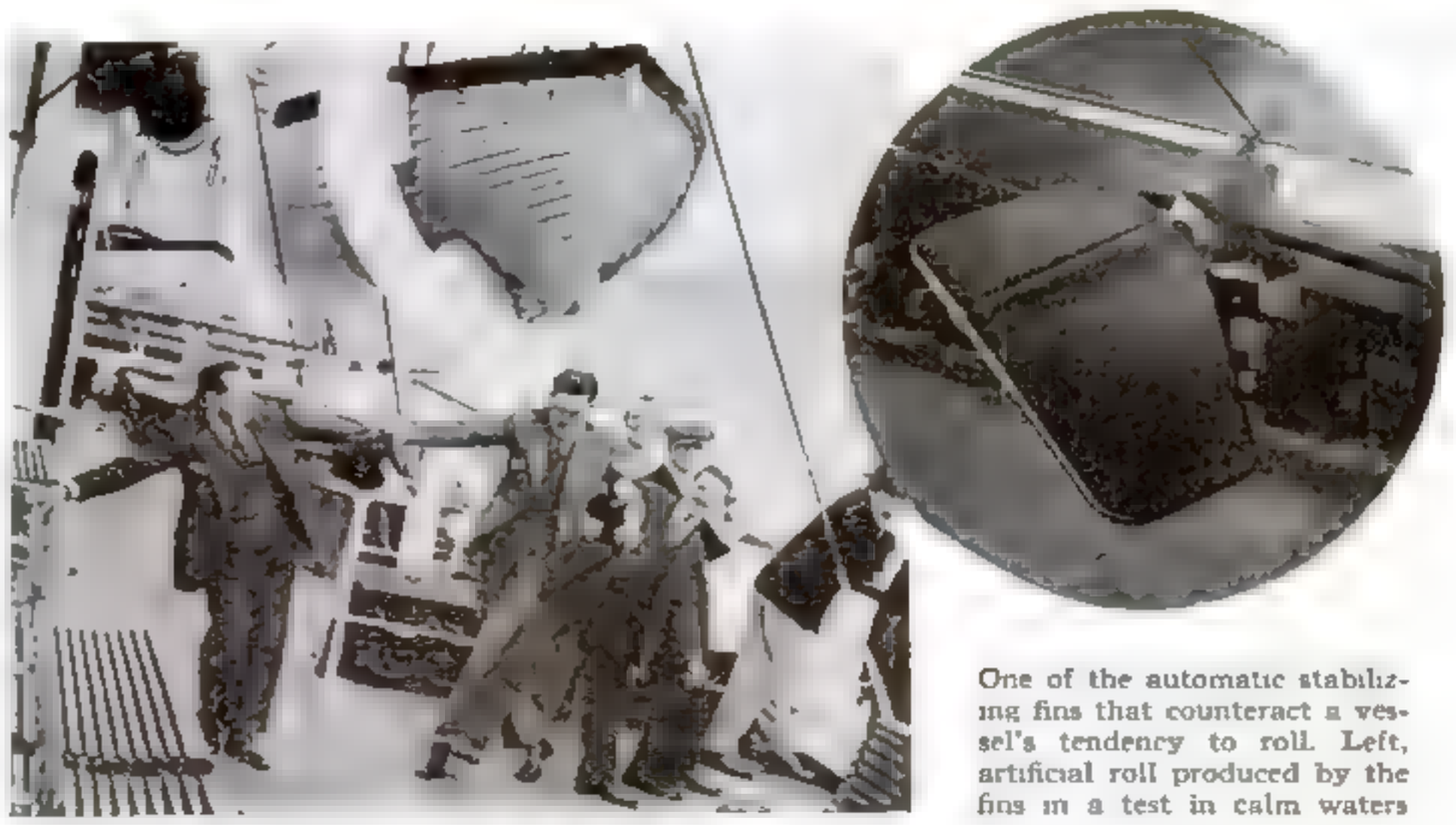
STABILIZING FINS CHECK STEAMSHIP'S ROLLING

STABILIZING fins for ocean vessels are a new aid to sufferers from seasickness. Any tendency of the craft to roll automatically tilts port and starboard fins in opposite directions, and the forward motion of the ship produces a stabilizing force that keeps it on an even keel. By tilting the fins in a calm sea, a vessel could be rocked artificially, as was purposely demonstrated in a recent trial of the invention on an English Channel steamship.



AUTOMATIC TORCH CUTS SHAPES IN METAL

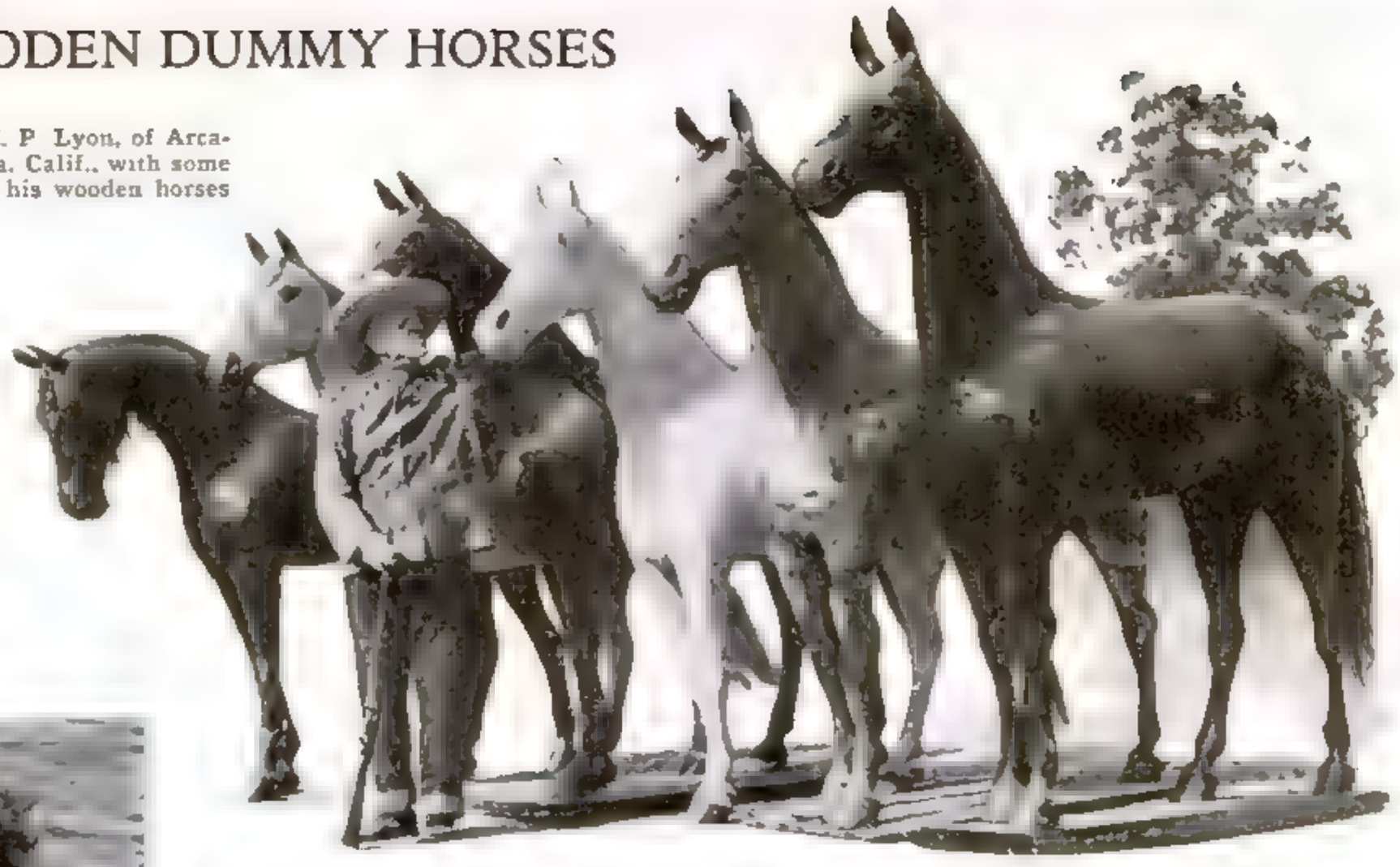
READILY piercing material as thick as twelve inches, the oxyacetylene flame of a new cutting machine slices metal into the simplest or most complicated of shapes. The torch may be guided by hand or set to follow a template, producing any number of duplicates of a desired form. Straight lines can be cut automatically in any direction and at any bevel. A special attachment also makes automatic the production of circles of various sizes.



One of the automatic stabilizing fins that counteract a vessel's tendency to roll. Left, artificial roll produced by the fins in a test in calm waters

COLLECTS WOODEN DUMMY HORSES

COLLECTING wooden horses is the unique hobby of W. P. Lyon of Arcadia, Calif., who houses the curios in his "Pony Express Museum." Once in general use to display saddles, harness, and other riding and driving accessories, the wooden dummies are now very rare. In his museum, Lyon exhibits the animals along with cigar-store Indians, old stagecoaches, and other half-forgotten relics of the pioneer days which he has gathered from all parts of the country.



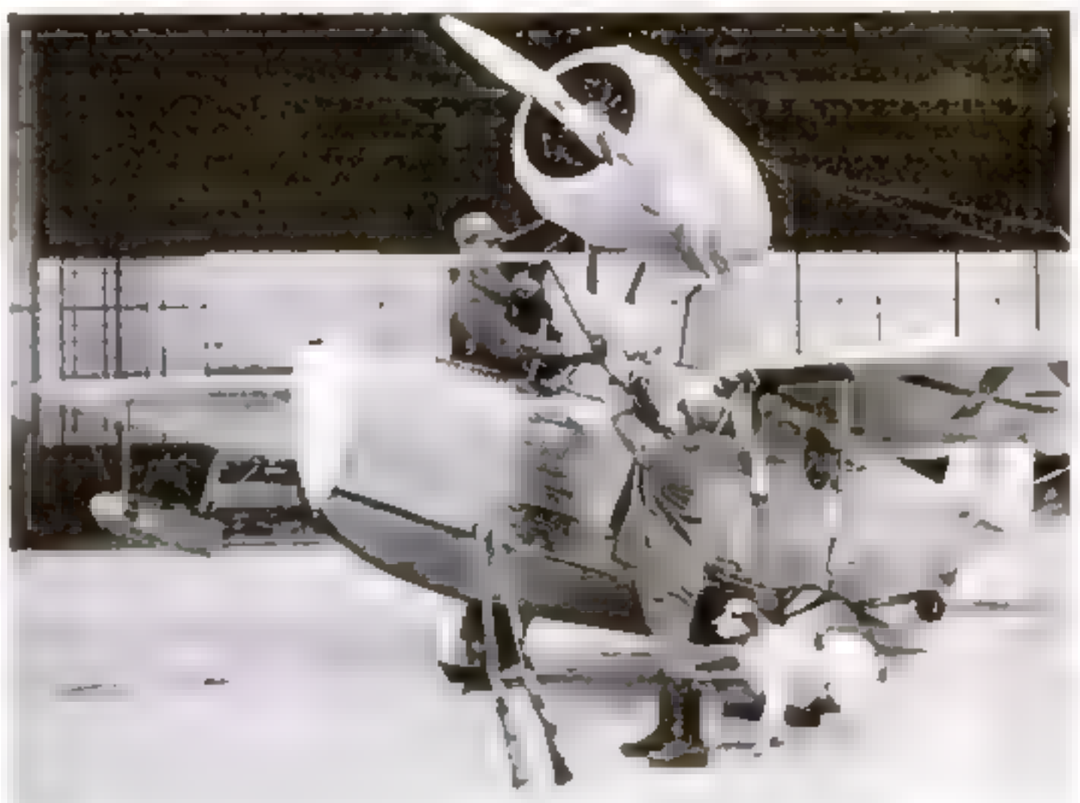
W. P Lyon, of Arcadia, Calif., with some of his wooden horses

HORN-SHAPED TELESCOPE GIVES UNDERWATER VIEW

LAKE bottoms, river beds, and ocean floors are easily examined with a submarine telescope now on the market. Shaped like a megaphone, the adjustable magnifier is placed in shallow water so that its large end is just below the surface. With clear water and sufficient light, the user gains an excellent view of interesting water plants, fish, and other marine life.

PLANE IS MADE OF STAINLESS STEEL

MADE OF welded stainless steel, a new amphibian plane just completed is in construction an aviation counterpart of the modern streamline railroad train. Exceptionally light in weight, the steel cabin plane carries four passengers. Powered by a 285-horsepower air-cooled motor, the amphibian airplane cruises at 135 miles an hour but can reach a top speed of 150 miles an hour. The wings and fuselage are virtually a one-piece unit.



Sportsmen loading their dogs for a hunting trip in the new metal plane

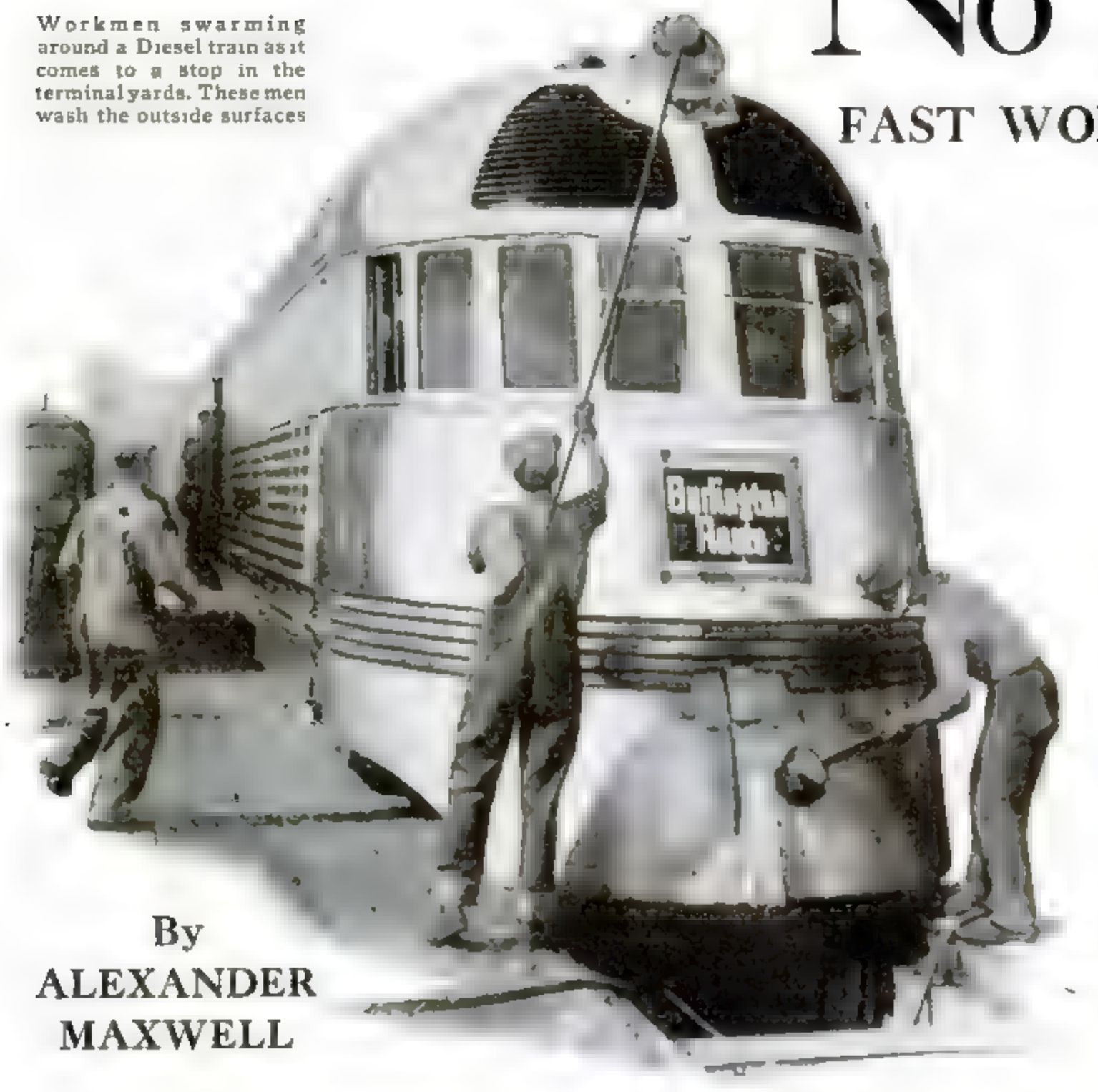
MUD IS USED TO BUILD MODERN LOW-COST HOUSES

Earth is dumped into forms like this and tamped down to form durable walls. The photo at the right shows one of the attractive mud homes

COMFORTABLE homes made of mud have just been completed by Government engineers near Birmingham, Ala., as an experiment in low-cost housing. Simple in design and easy to construct, the houses were erected on concrete foundations and roofed with insulating materials. Damp earth excavated on the spot was mixed with sand and shale, dumped into wooden forms erected on the foundations, and tamped down into solid walls seventeen inches thick. The rammed-earth walls effectively block out heat and cold, and are strong enough to withstand pressures as great as twenty tons to the square foot. Because the materials are cheap, the tools simple, and the construction process easy to learn, mud houses are expected to prove popular with home builders, especially in rural sections. To convince builders that earthen houses are durable, engineers point out that some of the oldest buildings in the country are made of rammed earth.

No Rest for

FAST WORK BY YARD CREWS



Workmen swarming around a Diesel train as it comes to a stop in the terminal yards. These men wash the outside surfaces

By ALEXANDER MAXWELL

SEEMINGLY unconcerned with the activity that surrounds them, a group of workmen loaf beside a tool shed in the busy Burlington Railroad yard in Chicago—swapping yarns, talking sports, and glancing occasionally at the battered alarm clock that hangs on a nail. It is 3:20 p.m.

From behind a string of day coaches comes the musical blast of an air whistle. Instantly the scene changes. Yarn-spinning stops. The men jump to their feet and stand ready with tools, hose, ladders, ice tongs. A silvery streamline train just in from Minneapolis and emptied of passengers backs toward them. Before it has glided to a stop, it is swarming with workmen.

Water hoses are snapped to tanks. Vacuum cleaners roar lustily within the coaches. Bundles of waste paper and rubbish are crammed into waiting sacks. Groceries and beverages are hustled aboard. Ice tanks are filled. The train is washed and polished inside and out.

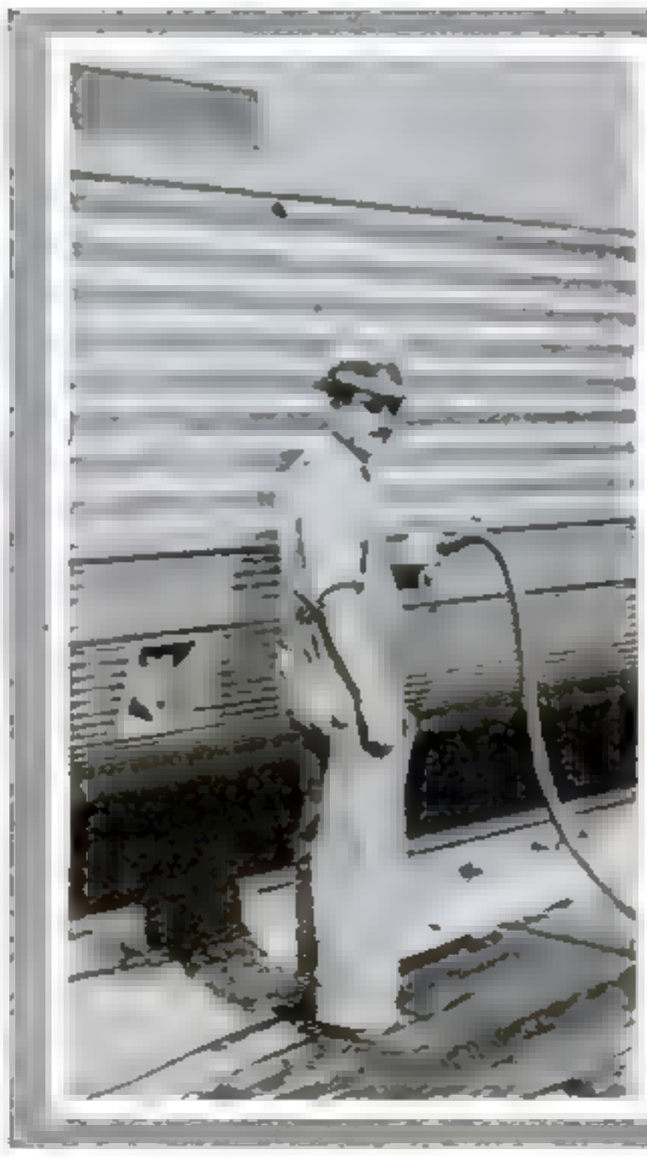
Skilled mechanics pull a cylinder head from the scorching-hot engine. An exhaust valve, stuck wide open, has put a cylinder out of commission. A squirt of kerosene, and it is back in order. The roaring inferno from the faulty cylinder has burned through an exhaust baffle, making the huge Diesel bark like an anti-aircraft gun. The remains of the baffle are yanked from the muffler, and a new one goes in. Weeds and grasshoppers have choked the air intake for the ventilating and air-conditioning system. Six men dive under the car to clear the screens.

One by one, the workmen complete their tasks. At exactly 3:40 a siren blows. A spurt of black smoke belches from the exhausts, and the booming roar of the Diesel fills the air. With bell ringing, the streamliner slides out of the yard and back to the Union Station, where passengers already are waiting to get aboard it for the return trip to the Twin Cities.

Working against time, like a pit crew in an auto race, the yard men have just twenty minutes for the all-important task of inspection and maintenance. Schedules for each of the Burlington's twin Zephyrs on the Chicago-Minneapolis run call for a 440-mile trip twice daily, allowing only one hour between runs for the train to unload and be turned around, cleaned, serviced, reloaded, and started on its way again.

Railroads are running ragged the few streamliners they so far possess, on schedules like this, to meet the unforeseen public demand to ride on them. Putting on more streamline trains isn't as simple as it sounds. Each one is a custom job. Building it takes a year and costs more than half a million dollars. Meanwhile, the pioneer streamline trains can't be withdrawn from use and sent to the shops for periodic servicing, like ordinary locomotives and coaches, because disappointed ticket holders refuse to ride on substitute steam trains. Six hours a day in the terminals is all the time out of service that schedules permit. So the railroads take their shops to the trains!

Every terminal has facilities for high-speed repairs, including a complete set of replacement parts. Wheels go first. The traction wheels on the engine begin to wear thin at 60,000 miles, while the trailer wheels under the coaches stand up twice as long or better. A trailer truck can be replaced in twenty minutes, simply by jacking up the two cars, sliding out



A hose connected to one of the tanks that supply water to washstands and other plumbing fixtures on the train

Inside the coaches, vacuum cleaners roar lustily as carpets and upholstery are put in order for another trip. This scene is in the cozy lounge at the rear

Streamline Trains

KEEPS THE DIESELS ROLLING

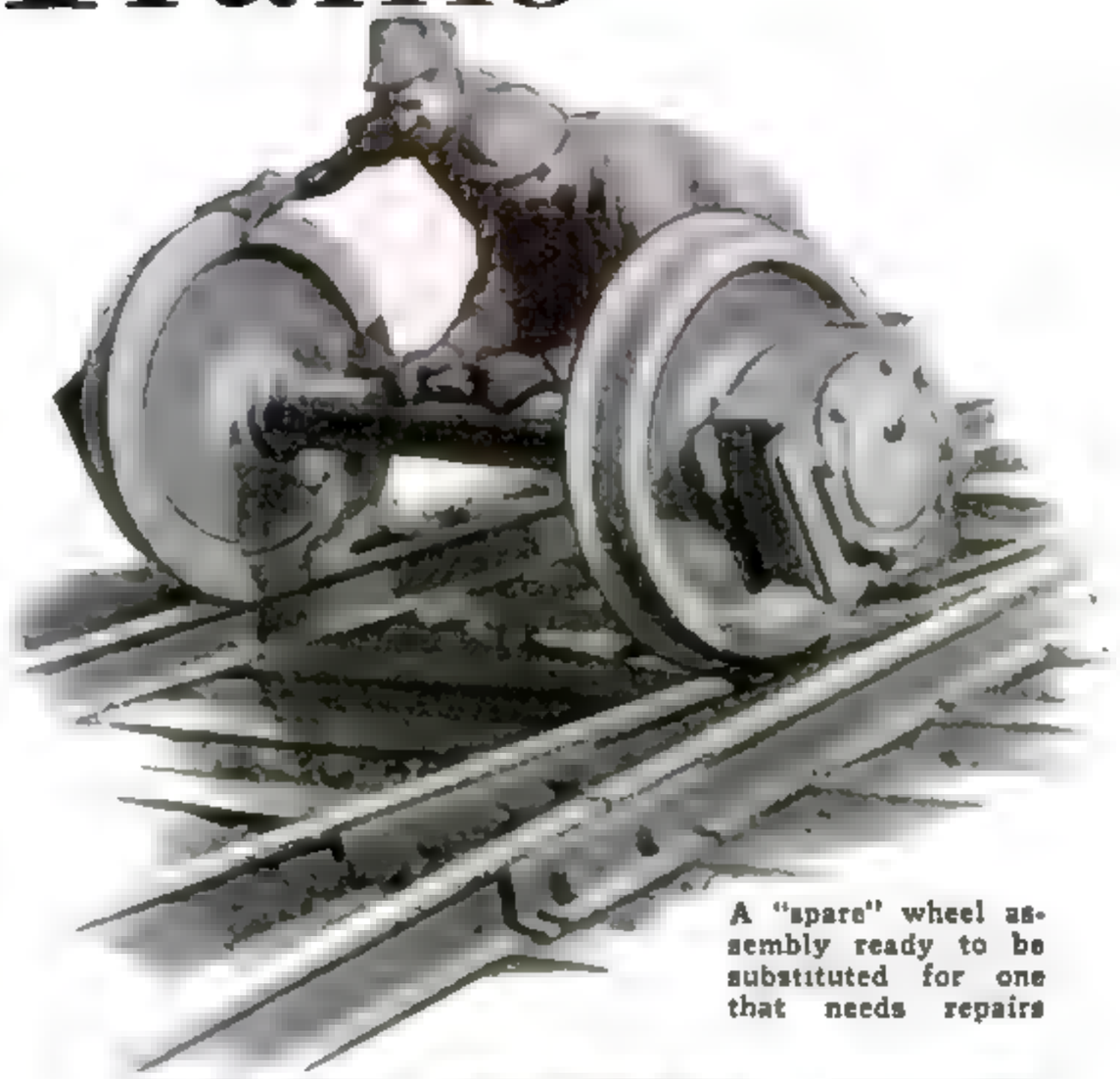
the old assembly, and sliding in the new. Few auto owners can change a tire in less time. What repairs are needed on the truck can be attended to in a machine shop, and that truck is kept as a spare until needed again.

The entire tractor assembly—drive motors, gear boxes, wheel and axle—can be taken out as a unit and a new one installed in five hours. In the same time, two cylinders of the Diesel can be pulled out and replaced; unlike an auto engine, it has no large castings, and new parts can be exchanged for defective ones in a jiffy. The engine and power car are so arranged that any part likely to be needed can be lifted in and out by man power alone, without resorting to block and tackle. A connecting rod is a load for one man, a cylinder reliner for two.

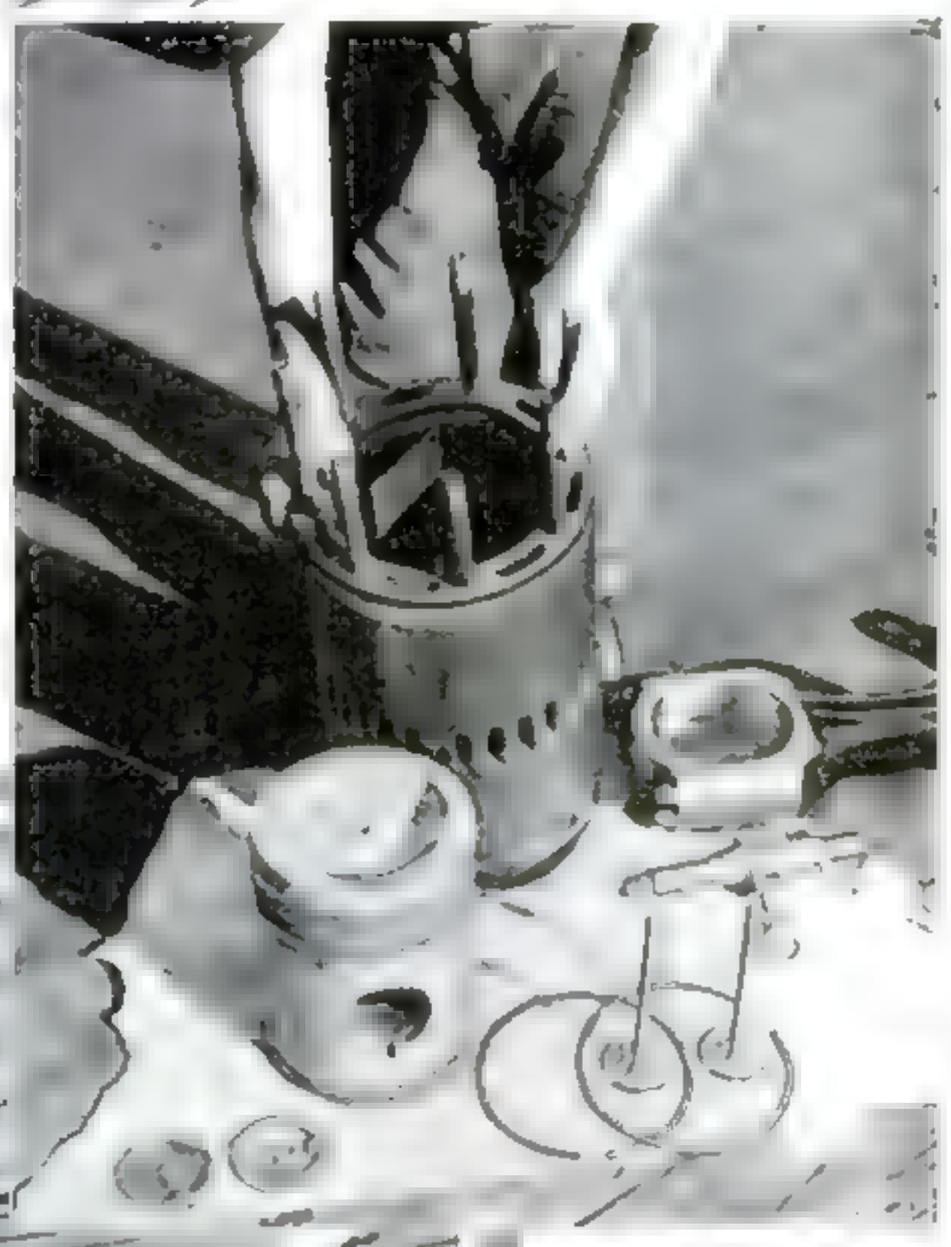
No rest for the streamliners! It seems incredible that any piece of rolling stock could be kept running almost continuously at operating speeds close to two miles a minute, for any length of time. Yet for two years they have been doing it. How much longer can they stand up? O. J. Mitchell, supervisor of motor cars for the Union Pacific, and E. F. Weber, Diesel-electric engineer in charge of the Burlington Zephyrs, give substantially the same reply: "Until they become obsolete!"

Unlike an auto engine, the Zephyr's Diesel has no arbitrary lifetime. The original Zephyr has traveled half a million miles and its crankshaft has worn less than two thousandths of an inch out of round—about the thickness of the glue on a postage stamp. At the present rate, the engine can run another million miles before the shaft needs to be removed for truing in a lathe. A streamliner's internal parts don't move as fast and wear as rapidly as its speed would make you suppose. While it is burning up the track at 120 miles an hour, its Diesel is loafing along at a mere 350 revolutions a minute. The engine of an auto traveling at that pace would quite likely be turning over more than ten times as fast. Even the traction motors, geared to the drive wheels, turn less rapidly than many a motor in your basement workshop.

Thus the streamliners, once called tin toys, are proving themselves able to take punishment that would tax the endurance of a steam locomotive and send an automobile to the junk heap. Their owners feel sure that, twenty years from now, the streamliners will still be running at speeds and on schedules as strenuous as today's.



A "spare" wheel assembly ready to be substituted for one that needs repairs



Replacement parts for a cylinder of the Diesel engine. They include a connecting rod, injector, exhaust valves, piston rings, piston, caps for wrist pins, and cylinder reliner. A pair of new cylinders can be installed in five hours

Taking on provisions. Groceries and beverages to supply the passengers during the return trip are waiting in the yard when the train arrives. A fresh stock of ice also is taken aboard

Yard men cleaning the screens of the ventilating and air-conditioning system. Weeds and grasshoppers, picked up on fast runs, choke the intakes if not removed daily

Are You Sane?

Illustrated by
B. G. SEIELSTAD

Gerard De Nerval, the French writer on political subjects, was indignant when police objected to his leading a live lobster on a leash through the streets of Paris. If people could air dogs, why not pet lobsters?

...MENTAL QUIRKS PRODUCE STRANGE BEHAVIOR

Before he could meditate effectively, the German poet Schiller had to put his feet on a cake of ice and inhale the aroma of rotten apples. His servants were trained to have these "props" always in readiness

By
WILLIAM WOLF

WHEN Johann Christophe Friedrich von Schiller, German poet, wanted to retire to meditate, the household went through one of the craziest procedures imaginable. Solemn-faced servants would take a cake of ice to the master's room and carefully place it in a bucket at the foot of a chair.

Schiller then would enter the room.

"Are the apples in the drawer as usual?" he would ask

The servants would reply in the affirmative. Certainly the apples were there; they would never forget to allow some apples to rot in the desk drawer!

Schiller would go to the drawer and take out the fermenting apples, carry them to his chair, and sit down. Then, and then only, could he think in peace —with his feet on the cake of ice and inhaling the biting aroma of fermenting apples.

Crazy? Not at all. A mark of genius? Hardly. John Jones, across the street from you, may exhibit eccentricities just as great; but such quirks stand out in men of genius. The world is full of people with phobias, obsessions, strange impulses which make them do curious things, manias, and other states of mind in which they perform acts not strictly sane.

Neither are these people insane; one psychologist employs the term "semi-insane" to cover those who have illusions, delusions, hallucinations, and fixed ideas or manias. It is hardly a fair description, for it includes just about ninety-nine percent of the population. Everyone is "just a bit off" in some respect.

A midwestern college professor with a strange phobia figured in the news recently. For several years he had been virtually a prisoner because he was afraid to go more than four blocks from his home, the victim of a strange dread of traveling. He attributed his phobia to an accident witnessed when he was a youth.

In the dark corners of the mind are hidden many fears and fixed ideas. The word "phobia" means "fear," and everyone knows other human beings who have phobias. They are morbid fears, paralyzing and will-destroying, and not the natural fear which makes humans alert to danger. Phobias make people helpless—as anyone knows who has a fear of high

places. Such persons feel an overpowering impulse to fall, to yield to the fear.

Some persons have strange fears of animals. Tycho Brahe, the famous astronomer, had such a phobia, for he was known to faint at the sight of a fox! Henry II of England went him one better, however, because he would fall over in a dead faint on seeing a cat.

Blaise Pascal, the mathematician, had a phobia of another kind. He couldn't see water without falling into a convulsion. He once said, "from the time I was eighteen years of age, I never spent a day without pain," and most of his suffering was due to his queer fancies and obsessions. He couldn't swallow anything that was not in liquid form—and then only drop by drop, piping hot.

There are countless phobias of the elements. A certain amount of fear of lightning is natural, but a friend of mine hides in a dark room whenever there is an electrical storm, cowering in an abject fear which he realizes is absurd, but which he is powerless to overcome.

The Greeks had words for many things, and psychologists and neurologists have borrowed some of them to describe certain phobias. By taking the word for dirt and adding to it "phobia," or "fear," they designate the fear of dirt as rupophobia. Belenophobia is the fear of pins. Aichmophobia is the fear of pointed objects, a common enough one. The cremnophobiac will stand on a precipice and turn pale, fearing that he is going to fall.

Many persons are subject to agoraphobia, and fear crowds or places where crowds collect. They would rather stay at home than go out and mingle with crowds. Directly opposite are persons with claustrophobia, for they dread enclosed places, would rather be out with people than in a home, refuse to stay in a room with the windows closed. hate elevators and Pullman berths, and regard walls of any sort with horror.

The list of queer things that otherwise sane persons fear is almost endless. Some fear sleep or swallowing, dread diseases, or imagine that they have diseases. Some won't walk over gratings in streets; others will carefully wash their hands after touching even a door knob for fear of catching a disease.

Two curious forms are hypophobism and panophobism. In the first, the subjects fear nothing; they are bold and audacious, blustering and self-confident. From this class come the "courageous" explorers so much admired by their fellow men, the adventurers equipped by their curious mental make-up to go through life unafraid to the point of foolhardiness. Panophobia is a vague fear of everything, and yet of nothing in particular. Dostoevski, the Russian novelist, suffered from it and has left a good description of the affliction. He said that he "had a frightful fear of something which I can not define, of something which I can not conceive, which does not exist, but which rises before me as a horrible, distorted, inexorable, and irrefutable fact."

SAMUEL JOHNSON believed that he kept himself well by tapping all the pales in fences he walked past

The inventors of "perpetual-motion" machines and the persistent writers of letters to public officials suffer from monomania, as a rule. It is their one abnormal streak in an otherwise normal mind. The dipsomaniac is not a voluntary drunkard, but one driven to drink by what amounts to a diseased condition of the mind. The kleptomaniac feels an overpowering impulse to steal whatever appeals to him. He is like a magpie, stealing without thought, and large stores are thoroughly familiar with his ways. Often, a store has orders to keep check on what a kleptomaniac steals, and his family pays for the articles.

Illusions are common to the race of man, but when the individual believes that his inaccurate perception of something is accurate and real, then the illusion assumes a pathological character. Hallucinations are inaccuracies of the perception, too, but with the added factor that imagination, usually of a subconscious nature, is required to make them seem real.

Obsessions proper differ from phobias in that the subject's anxiety expresses itself as a fixed idea rather than as a fear. Sir Isaac Newton had an obsession of doubt in which he would count his change over and over after buying an article, unable to decide whether it was right, although he was the world's foremost mathematician! Others have obsessions of words, or numbers, or songs, which they will repeat constantly. The nosophobic obsession, or fear of disease, is common—especially among doctors and nurses. Those with an obsession of contamination will wash their hands constantly, wear gloves, and change them every day.

The pyromaniac, the person with a homicidal or suicidal mania, and those with sitiomania, or desire to eat all the time, are other examples of strange impulsions. Then there is echolalia, the urge to repeat at once and like a parrot any word heard or read, or even one's own thoughts.

There is still another queer freak of the mind wherein the victim is given to autoscopy, either internal or external. In internal autoscopy, the subject believes that he can feel and picture the inside organs of his body, or that he can trace the course of a foreign body through the alimentary canal. In another form, the victim of the delusion imagines that he sees himself standing before him.

An utterly mad form is that known as negative autoscopy—the subject can't see himself in a mirror!

So much for the types. These hallucinations, obsessions, phobias, and manias are general, but they strike the observer more when noticed in men of genius—and there are few men of genius exempt from some peculiarity.

Musicians have been particularly noted for their peculiarities, and they are not all expressions of temperament, by any means.

Rossini, the composer, for instance, had severe neurasthenic attacks after he reached middle age. In an amazing flare-up of musical genius, he wrote thirty-six operas in nineteen years—and then suddenly stopped after writing "William Tell." He had fits of weeping, attacks of despair, and was given to suicidal impulses. "I feel all the miseries of a woman," he once complained.

Beethoven was very eccentric. He preferred ice water to wash in, and would splash it on his face, scolding furiously all the while, slop *(Continued on page 123)*

NOT AS EASY AS IT LOOKED

A brother of Thomas De Quincey, the English essayist, made a desperate effort to learn to walk on the ceiling with his head down, in imitation of a fly

Tiny Homemade Planes

BRING MORE SPEED TO THE AIRWAYS

A mechanic "doping" the fabric at the junction of propeller blade and spinner on a small plane, to make it present a smoother surface to the stream of air. In the photo at the top of the page, a pilot and ground crew are checking a racing motor

The engines of these high-speed planes must function perfectly. Here an engineer is testing the gas mixture of a motor through an exhaust port, to guard against the peril of engine failure in the air

FROM out-of-the-way corners of small-town garages, a dozen daring young pilots, most of them still in their twenties, ride streamline broomsticks into the sky and give the nation each year new speed thrills which pave the way for the development of faster racing and commercial airplanes.

They are to aviation what the drivers of racing automobiles are to the automotive world. They are at once the designers and the human guinea pigs who test their daring inventions and innovations, often at the risk of their lives.

Harold Neumann, in private life an air-line pilot, leads the list of these ace flyers of baby planes. He won more races, and consequently more money, during the last year, than any of his competitors. The much-envied number 1 adorns the sides of his fuselage whenever he flies his cantilever midwing Folkerts special around the pylons.

But Neumann, like others of the scientist-pilots, is more than a flyer. In a Waterloo, Iowa, garage, with Clayton Folkerts and Ted Fordon, he produced earlier this year something new in racing airplanes. Not only did he equip his plane, whose plywood-covered wings stretch only sixteen feet from tip to tip, with wing flaps which enable him to land with some assurance of safety, but also with fully retractable landing gear which he snaps up into the fuselage when the wheels clear the ground, thus making it possible to pick up speed the instant he's in the air.

Once the wheels fold up within the recesses, Neumann closes two trapdoors which give a smooth streamline form along the fuselage. The fuselage itself is unusually long and narrow, permitting a streamline effect which has been enhanced by equipping the propeller hub of the engine with an extension shaft that carries the propeller a foot beyond the nose of the motor and permits further streamlining at the nose.

Speed, and still more speed, is the goal of all these pilots. Whenever Neumann succeeds in building a plane which will zip around the pylons five miles an hour faster than his nearest rival, his competitors—Arthur Chester, Lee Miles, Ben O. Howard, Marion McKeen, R. A. Kling, S. J. Wittman, Joe Jacobson, David Elmendorff, Harry Crosby, Roger Don

Harold Neumann, America's small-plane speed king, in his new midwing Folkerts special. Note the cockpit cover that completes the streamline fuselage shape

Crowded into small space, as in the picture below, pilots have little chance to escape disaster in the air. Many of them do not carry parachutes

The latest in retractable landing gears. These wheels on Harold Neumann's midget racer snap up into the fuselage when a trigger is released. They are wound down again by a hand crank

Riding Flying Broomsticks Through the Sky at 250 Miles an Hour, Dare-Devil Young Pilots Try Out New Developments That Pave the Way for Faster Flying

By Andrew R. Boone

Rae, and Ralph Bushey—though separated by thousands of miles, set out to improve their own planes or build new ones which will wrest the laurels from America's small-plane speed king.

Soon the roar of engines is heard at scattered airports as new and rebuilt planes are tuned up, ready for hazardous test flights. Pilots squirm into the cockpits, often without parachutes with which to save themselves in case a wing shakes off, or flames break out from an overheated engine. On narrow wings, the squat little planes roll forward, waver, roar into the sky, with fame or oblivion riding behind the whirring propellers.

Anything can happen on these flights. The engine may "freeze," retractable landing gear may refuse to come down, rain may strip the linen from the wings' leading edges, the propeller may throw gravel into the stabilizer.

And, sometimes, nerve-tingling experiences do visit these merchants of speed. One pilot took off from a southern California field to test-fly a new racer. He circled the field three times as he climbed for altitude. Nearing completion of the third circle, his oil pressure dropped; he banked over high-tension wires, dropped down to the runway, and skidded 200 feet on the belly of the narrow fuselage. He had forgotten to wind down his retractable landing gear, and scooted in like a stone barge. Excepting for a bent propeller, he and his craft miraculously escaped injury and damage in a 100-mile-an-hour landing.

Although they take many risks which look foolhardy to the casual observer, pilots of the small racers approach their jobs with the detached attitude of scientists.

"We must be sure, first, that the motor will not fail on a take-off," Neumann told me as he prepared to test his new monoplane recently. "We check the gas mixture carefully, and may find the engine runs cool on the ground, only to heat up when it begins to pull in the air. For that reason, I favor my motor during early flights, and do not use maximum power until it has been well run in.

"I fly first from the largest and smoothest airport I can find, and, if possible, take off into a twenty-mile wind toward open fields. I give the engine half throttle, roll slowly down the field, and, when I'm sure I have the feel of the ship, begin to open the throttle until the ship takes herself off the ground."

In the air, the pilot of a racer circles the field as he climbs the 800-pound plane up to an altitude of 3,000 feet. There he checks his instruments, tries the controls, studies the ship's behavior, and comes down to a fast landing. Following three such flights, he begins to open the throttle wide, trying the craft out at various altitudes to study its reaction to speed. Then he begins to apply the wing flaps in landing, first half-flap and finally full-flap, slowing his landing speed down to sixty miles an hour. Meanwhile, he adjusts his propeller setting for maximum efficiency at full throttle, for these planes are designed to fly closed courses as fast as their high-speed engines will carry them through the air.

Everything on one of these planes is specially made for that particular ship, except the one most important unit—the motor. All these are commercial engines, "souped up" to get all the horsepower possible. These planes cost from $7,500 to $15,000, depending upon how much engineering aid the owner secures, and how much help he has in building his plane.

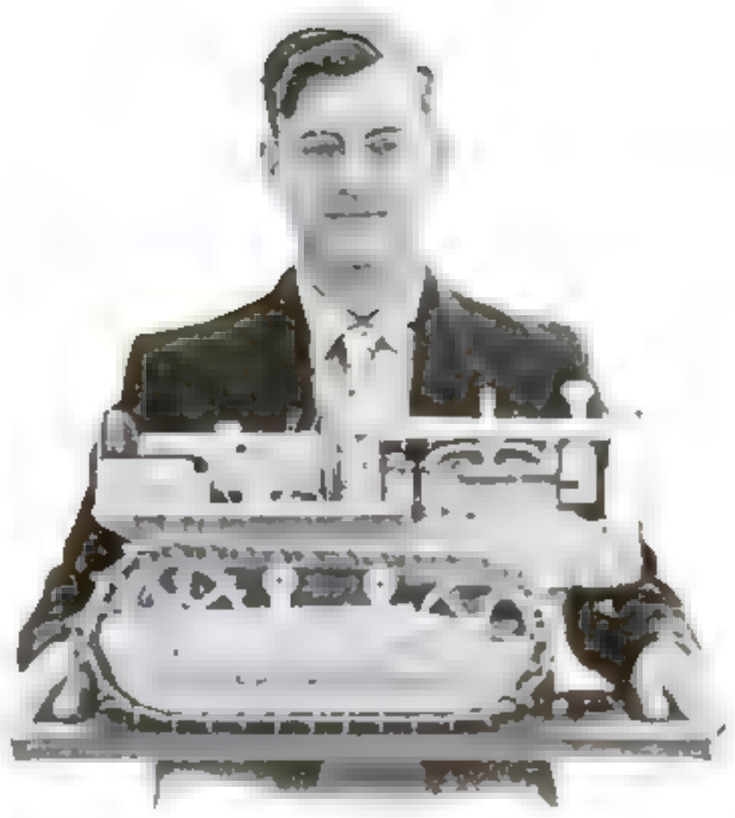
A winner this year is not likely to be a victor next year, for other new ships will spring up from back-yard garages with a mite more speed. To meet the ever-increasing speeds. *(Continued on page 134)*

MOBILE ARMY DARKROOM IS GASPROOF

This trailer unit contains a complete darkroom for developing photographs made by Army aviators. Below, in the printing room

The man is holding the air-filter box of the ventilating unit. The inset shows the blower

EVEN in the midst of an enemy gas attack, soldiers can go right on developing pictures in a photographic trailer designed by the U. S. Army Air Corps at Wright Field, Dayton, Ohio. Its air-conditioning system employs an air filter of loosely packed material, for which a cartridge containing a chemical that absorbs poison gas can be substituted in time of need. The mobile unit is equipped to turn out work more rapidly than most standard laboratories. A lightweight electric generator supplies current for a pump that draws water from any near-by stream or lake, and extra water is carried in a large reserve tank for emergency use.



BUILDS ACCURATE MODEL OF DIESEL TRACTOR

ACCURATE in every detail, a twenty-two-inch model of a Diesel farm tractor built by nineteen-year-old Richard Young, of Ithaca, N. Y., required four and a half months to complete. Constructed on a scale of one to six, it is declared by experts a perfect copy of the 9,550-pound machine that it represents. The four-cylinder engine, made of cork, pine, aluminum, copper, and brass, is complete even to fuel injection pumps, lines, and injectors. For the tracks alone, the young builder had to cast 1,054 metal parts. Aluminum furnished the material for the track frame, hood, and seat, and the latter is upholstered with leather as in full-sized machines. Total weight of the tractor model is thirty-two pounds.

SAFETY CATCH RELEASES LIFEBOAT

A lifeboat being launched in a demonstration of the new safety device. Right, an officer examining the clamp that releases the lowering cable

A NEW safety device for lifeboats, just installed on a French liner, is designed to minimize the danger of the boats' capsizing while being launched. Attached to the lowering cables, the apparatus grips the lifeboat securely until the instant it touches the water. The safety clamps snap free as the launched boat, buoyed up by the water, releases its heavy pull on the lowering cables.

PLAYING CARDS ARE WASHABLE

PLAYING CARDS made of a new substance resembling artificial silk can be scrubbed clean with soap and water, as at left. So inhospitable to stains is the material that chemists are said to have experimented for three months before finding an ink that would print upon it.

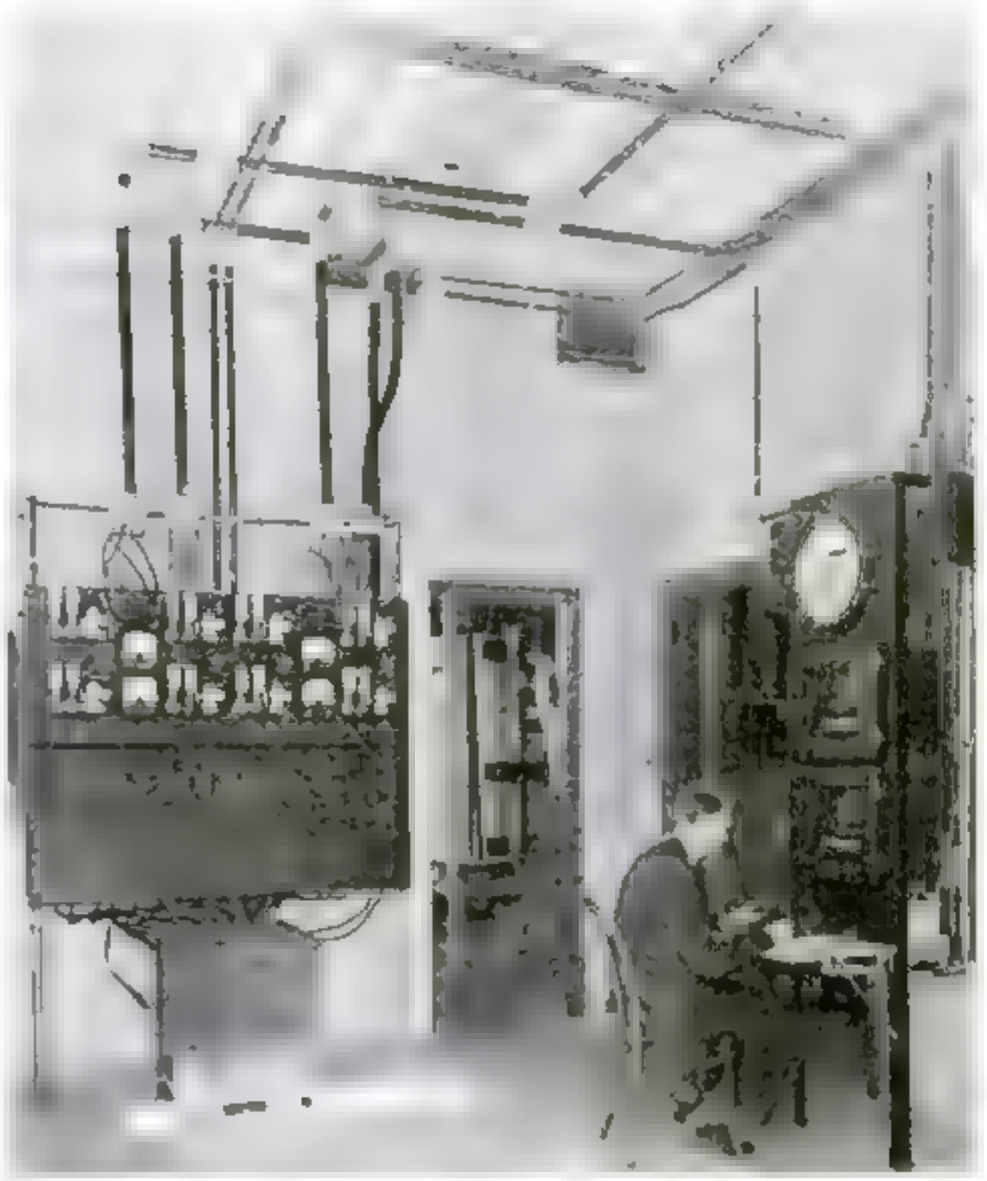
CORK KEEPS LIQUOR UNDER LOCK AND KEY

A NEW locking cork prevents the "mysterious disappearance" of choice liquors, and keeps poisonous liquids in the medicine chest from being taken by mistake. Only the holder of its key can release a pair of metal balls that press against the glass to clamp the stopper to the bottle neck.

Turning the key moves two balls that lock the cork in the bottle

Gasoline Made from Coal In New Laboratory

Exterior view of the gasoline laboratory. The hydrogen storage tank is at the right



Protected by thick concrete walls, observers in this control room can regulate the operation of the entire plant

BECAUSE the nation's oil reserves may be exhausted long before its coal supply, scientists at the U. S. Bureau of Mines Experiment Station in Pittsburgh, Pa., are experimenting with a chemical process for making gasoline and oil out of coal. In a hillside laboratory, isolated because of the constant danger of explosions, hydrogen gas is manufactured from natural gas and steam, and stored in high-pressure tanks. Coal is washed thoroughly, ground into powder, combined with oil or coal tar, and mixed with chemical catalytic agents to speed the reaction. The mixture is then pumped into a thick-walled converting cylinder, where it joins the hydrogen gas and is subjected to temperatures up to 500 degrees centigrade and pressures as great as 5,000 pounds to the square inch. After a sufficient period, the pressure in the converting cylinder is released by a system of air traps, and the gasoline and oils drawn off. When experiments are completed, chemists expect to convert every 100 pounds of coal into sixty pounds of gasoline and oil, the forty-pound residue consisting of ash, coke, moisture, and gases. Made of strong, stainless steel, the high-pressure coal-converting cylinder is housed in an explosion chamber having eighteen-inch walls of concrete and steel to guard against the hazard of accidental blasts. The operation of the entire plant is regulated from a central control room, in which gauges show how the various processes are being carried on. Heavy observation windows between the converting chamber and the central control room are made of laminated glass four inches thick.

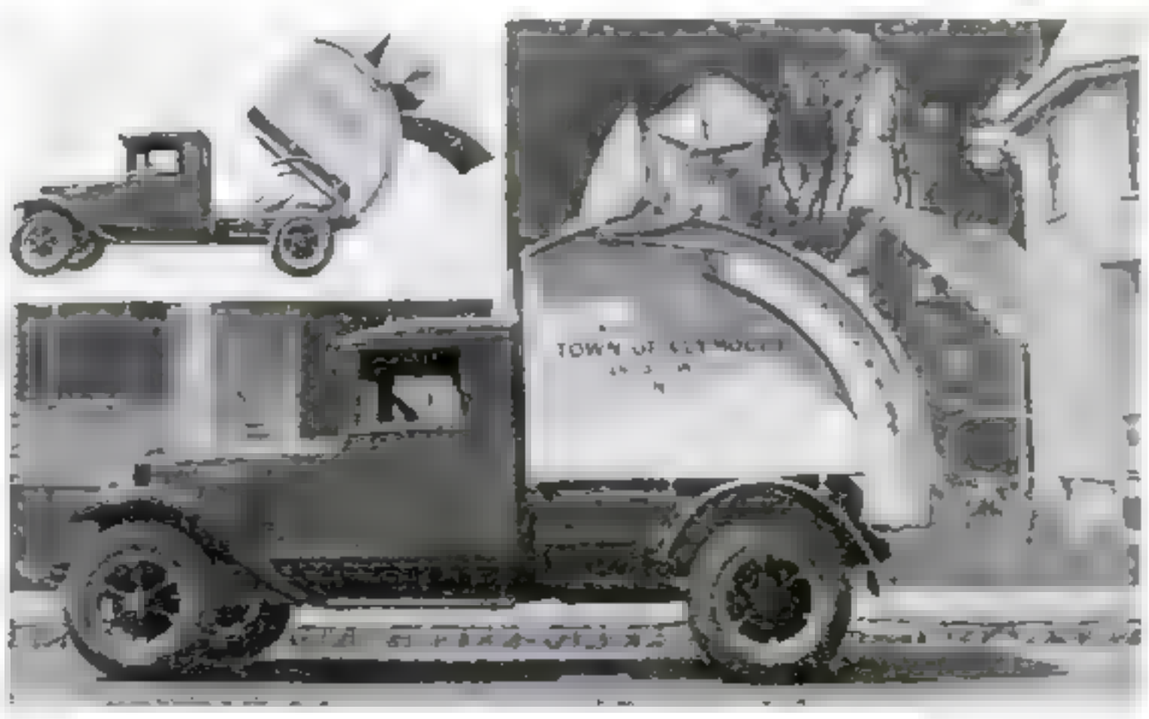
RAILWAY TRAIN IS TEMPORARY SCHOOL

Fitted with shelves and benches, a coach serves as a school laboratory

RAILWAY cars serve as classrooms for high-school students of Helena, Mont., while new school buildings are being erected to replace those demolished by earthquakes. Loaned by railroads, the coaches were run onto a siding and connected to a heating plant. Some are fitted with shelves and tables for laboratory classes in science subjects.

BUCKET LOADS REFUSE TRUCK

SANITATION trucks of a new type have just been placed in service in Plymouth, Mass. When collectors deposit refuse in an elevating bucket suspended at the rear of the machine, it is hoisted upward and dumped through an automatic trap door opening into the fully enclosed body of the truck. Thus refuse is effectively concealed from sight, and no objectionable odors escape while the truck is passing through the streets.



A traveling bucket loads this new-type refuse truck. Top, how it is dumped

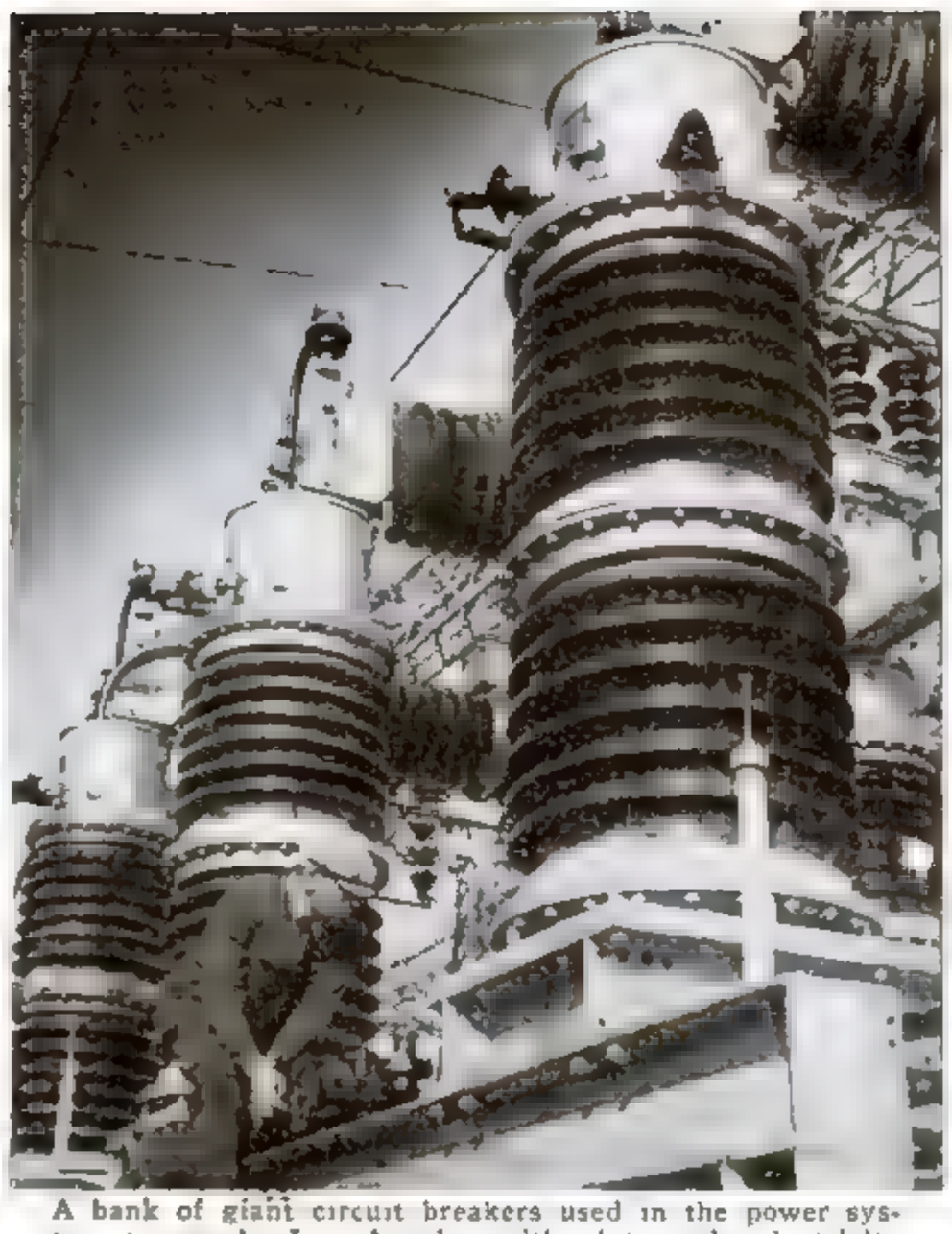
BRACE HOLDS BONES FOR SETTING

A NEW mechanical device to aid in the treatment of broken arms and legs was recently demonstrated before doctors of the Michigan Medical Society in Detroit. Made of rustproof metal, the machine can be adjusted to hold an injured limb in a steady and immovable position while a regulation plaster cast is being applied. The new apparatus is said to insure a much more accurate setting of a badly fractured bone than is possible by methods now commonly employed by physicians for this purpose.

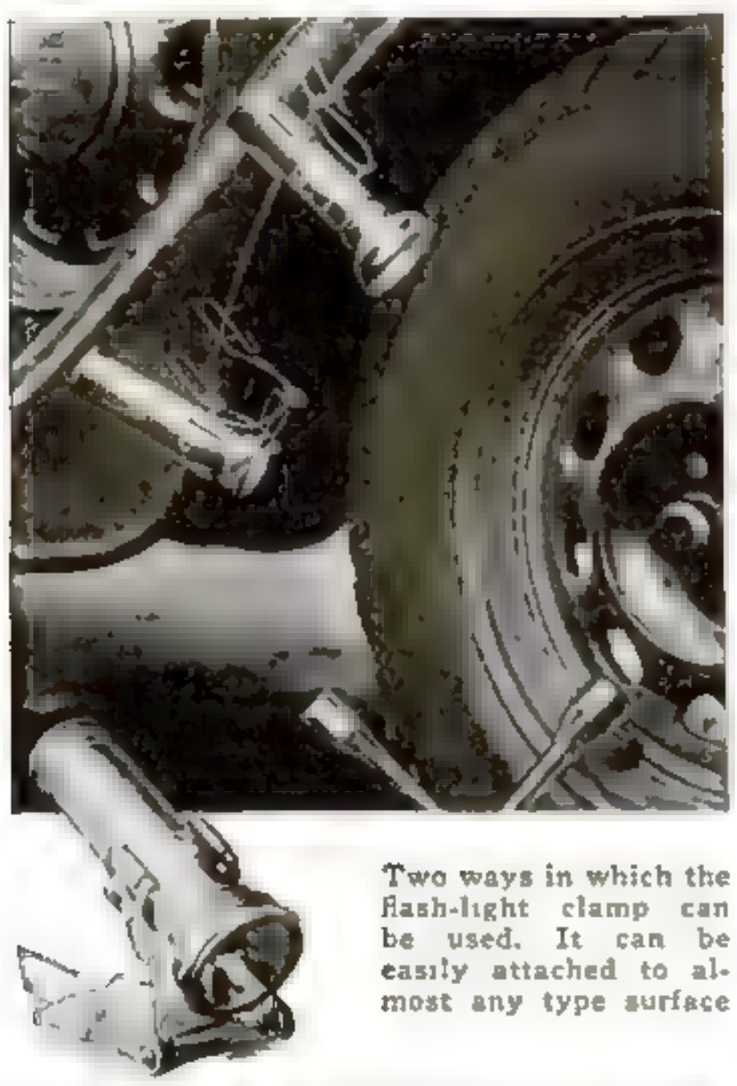
Experts altering electric clocks so they will operate on sixty-cycle current

READJUST CLOCKS FOR BOULDER DAM POWER

TO KEEP the newly opened $23,000,000 transmission line from Boulder Dam from playing havoc with the daily schedules of Californians, hundreds of electric clocks used in homes and offices in Los Angeles had to be made over not long ago. Preparing to conform with the new source of supply, which distributes electricity to homes and factories through the world's largest cables, transformers, and circuit breakers, the municipal power plant altered its system from fifty-cycle to sixty-cycle current. That meant that one-fifth as many electric impulses as before traveled out over the city's wires each second. Since electric clocks contain tiny motors operated by these impulses, they would have gained twelve minutes an hour if not readjusted.



A bank of giant circuit breakers used in the power system to supply Los Angeles with sixty-cycle electricity



Two ways in which the flash-light clamp can be used. It can be easily attached to almost any type surface

HANDY UNIVERSAL CLAMP HOLDS FLASH LIGHT

HOLDING a flash light at any desired angle, a new detachable bracket may be fastened to a car window or fender, a door knob, a water pipe, or any of a thousand other spots to shed illumination just where it is wanted. Rubber wheels on the holder serve as a buffer, and also enable the flash light to be placed on a table or any other convenient flat surface.

CANDY FROM COAL TAR

CANDY stores in Berlin, Germany, are now offering for sale "chocolate bars" made from coal tar. Although it looks like soap, the synthetic food is said to taste like chocolate. No effort is made to disguise it by artificial coloring.

NEW BATH FOR PARALYSIS VICTIMS

AN "HOUR-GLASS" bathing tank may soon bring relief to young victims of infantile paralysis and older sufferers from arthritis, if preliminary tests of the device at the New York Post-Graduate Medical School and Hospital of Columbia University prove successful. The apparatus is designed to bring metropolitan patients the equivalent of warm-water cures at distant resorts, plus a healing massage from bubbles of air forced through the water.

Nurses preparing to give a patient a treatment in the "hour-glass" bath

The two inventors demonstrating their odd mechanical brain

ELECTRIC BRAIN "REMEMBERS"

AN ELECTRIC counterpart of a human brain, devised by two American psychologists, can learn, forget, and show fits of temperament. Storage cells and relays are so arranged that pressing one button lights a white lamp, a second a red, while a third can be "taught" to work either lamp by first pressing it together with the "white" or "red" button. Occasionally the machine makes mistakes, and may then balk at another try as if discouraged. When it gets a lesson right, it appears to gain confidence.

Playthings Teach Arithmetic

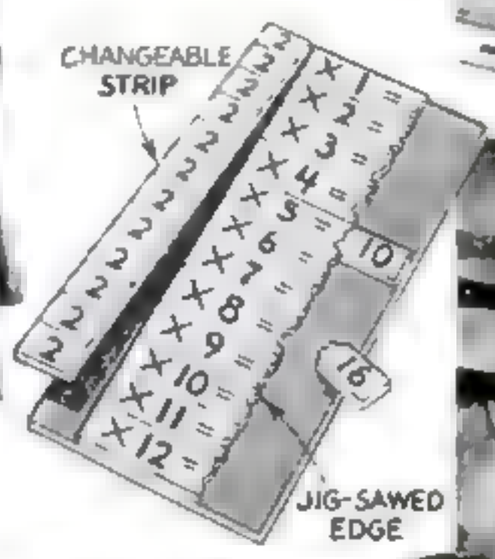
"PAINLESS LEARNING" MADE POSSIBLE BY USE OF BLOCKS, BOXES, BALLS, AND MARBLES

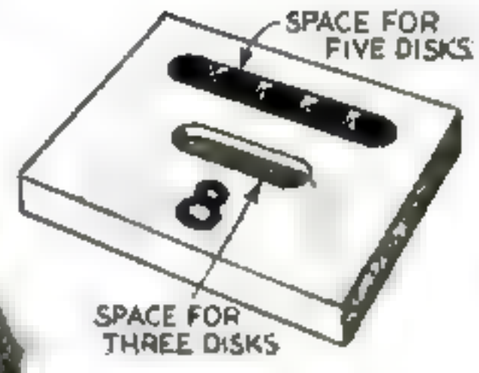
COMBINATIONS OF NUMBERS. This youngster is mastering the mysteries of counting by placing brightly colored marbles in rows of holes on a board. The teacher explains nothing in any of these exercises, but permits the pupil to learn his lesson by trial and error

NOVEL wooden toys, designed by a New York psychologist, provide a new means for teaching children the rudiments of arithmetic. Extremely easy to construct, the toys consist of jig-saw puzzles, boxes with sliding panels, checkerlike disks, blocks, and marbles, all brightly colored to attract and hold attention. Turned loose in a nursery equipped with the arithmetical playthings, youngsters are said to treat them as exciting games and teach themselves to count, recognize numerals, add, subtract, multiply, and divide with little or no guidance. To learn multiplication, for instance, the child selects numbered wooden pieces jig-sawed on one side, and tries to fit them against the uneven edge of a wooden panel containing a simple multiplication table. In the "two-times" table, shown in the illustration, if the child picks up the piece numbered ten,,he soon learns that it will fit into the multiplication table only at the place next to the legend "two times five." Subtraction is taught with the aid of an oblong box with holes drilled in the top; five colored balls rest on a sliding panel placed just below the box top. As the child slides the panel out, the balls drop from sight into the box one by one, while the numerals from one to five appear on the slide as it emerges. Counting and simple addition are learned by placing brightly colored marbles in rows of holes in a flat board. The process of division becomes apparent to the child as he watches the teacher duplicate a square of wood by fitting together half and quarter sections. Children are said to be so intrigued with the arithmetical toys that it is hard to make them leave off "study."

LEARNING TO MULTIPLY

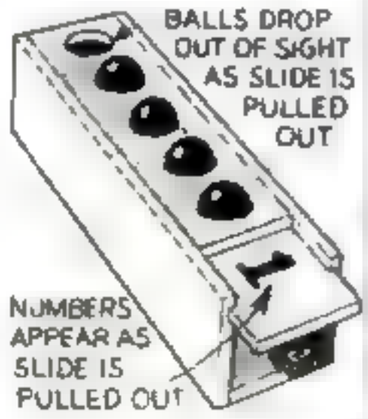
Numbered pieces, jig-sawed on one side, are fitted against the uneven edge of a panel containing a multiplication table. Each piece will fit only where it supplies the right product as answer

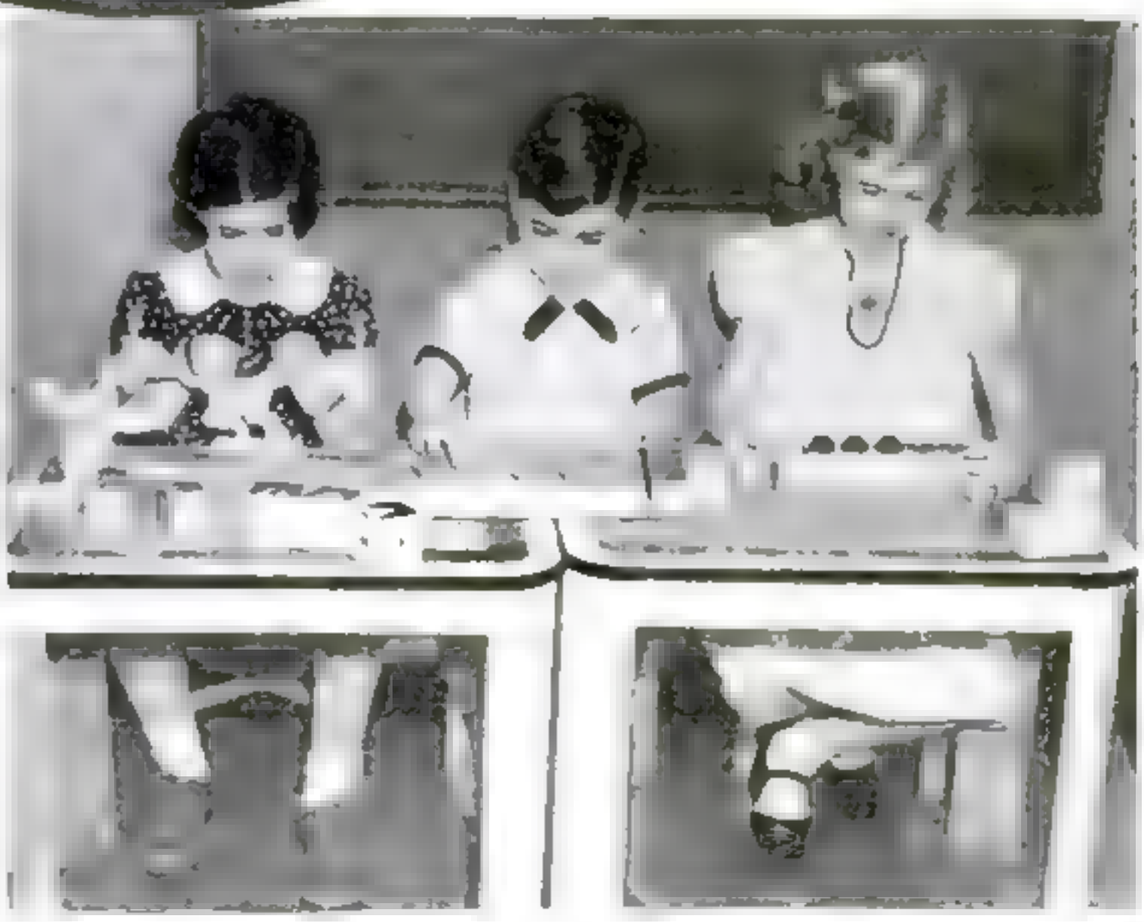




ADDITION MAKES SENSE THIS WAY

At the left, a child is learning to add by placing counters into shallow grooves in a board. Each groove holds only so many counters, and the sum is written at the bottom of the board. Handling the counters impresses the sum on the child's mind





HARD AT WORK

Three pupils "doing their arithmetic." The girl at the right is using a box that has a sliding panel which allows balls to drop in one at a time, illustrating subtraction

Back of this tinsel-decked tree is an interesting story. At the upper right, woodsmen are cutting the trees, sawing off the butts, and tying them into bundles. Right, some of Maine's annual quota of 500 carloads of evergreens waiting for shipment

Your Christmas Tree...

THE PRODUCT OF A $10,000,000 INDUSTRY

AN AMERICAN woodsman tramped out of the Catskill Mountains in the winter of 1821 with what is said to have been the first Christmas tree ever sold in the United States. When he disposed of it in New York City, he inaugurated a vast and curious industry.

Today, approximately 9,000,000 Americans purchase Christmas trees each year. As early as October, an army of choppers begins work, and by the first week in December thousands of flat cars are rolling southward from Canada, from Maine, from the swamps of Michigan and Minnesota, and from the mountain sides of the West. The annual outlay for trees and wreaths now exceeds the $10,000,000 mark. Santa Claus is a prize patron of the north woods.

Nearly half of the trees sold in the United States come from one state, Maine, and the bulk of these come from one county, Washington, on the New Brunswick border. According to the Maine Forest Service, approximately 4,000,000 Christmas trees are cut each winter. Since 1922, one railroad, alone, has hauled 1,000,000 a year out of the state. They have been consigned to cities in nearly half the states in the Union, with the coal mining and industrial sections of Pennsylvania topping the list as buyers.

The biggest single market, of course, is New York City. It uses about one tenth of all the trees sold in the country. One man, Fred H. Vahlsing, an enterprising wholesale produce dealer, supplies from fifteen to twenty percent of the trees sold on the island of Manhattan. He is known as the "Christmas-tree king of New York."

In addition to the local sales, Vahlsing ships several carloads of evergreens abroad where they are sold to Americans unable to return home for the holidays. Most of these trees go to Central America, Cuba, and Jamaica.

Behind the sudden appearance of millions of trees on the market each Christmastime, there lies weeks of intensive and well-organized activity. How the trees are selected, cut, shipped, and sold can best be understood by following the footsteps of Vahlsing during one season.

Shortly after the Fourth of July, he starts getting ready for the yuletide rush. His scouts head into the interior of Nova Scotia, combing abandoned pastures and open spaces for likely growths of balsam fir. In open pastures and wood lots, the trees have a better chance to develop the symmetrical shape desired. The ideal Christmas tree is symmetrical, has a dense and compact crown, possesses branches sufficiently stiff to hold decorations well, is fragrant, and retains its foliage in a

A direct-to-consumer sale: a citizen buying a tree at a ranger station in a national forest

An Army of Woodsmen, and Many Miles Of Railroad Flat Cars, Are Required To Supply Uncle Sam's Holiday Needs

By GROVER C. MUELLER

The Christmas-tree yard at a forest station in Cibola National Forest, New Mexico. Trees raised here are cut and hauled to a central depot for sale to the public at a low cost

warm room. Balsam and spruce combine these features best and are most widely used.

After the trees have been found and bought, Vahlsing organizes crews of native woodsmen. Even before Halloween arrives, these cutting crews are hard at work. Swinging double-bladed axes, they lop off the young trees and then cut off the butts squarely with bucksaws. Leaves are heaped over the piles of cut trees to protect them while they are awaiting shipment. Sometimes the butts are placed in water to increase the moisture content of the wood so the needles will remain on the boughs for a longer time. During a moist or rainy fall, this precaution is unnecessary.

By Thanksgiving, the trees are riding on trucks and hay wagons to the railroad sidings where they wait in green mountains for the arrival of the flat cars on which they will be loaded. According to their size, the trees are tied into bundles containing from two to five evergreens. These are packed on the flat cars between upright posts ten feet high. One car can carry from 1,800 to 4,000 trees.

For seven days, the cars roll southward, arriving in New York about December 10. Retailers buy the trees directly from the cars or from an open market where Vahlsing displays them on West Street. The wholesale price runs about two dollars a bundle, being governed by the scarcity of the trees. In some instances, the price jumps to five, six, or even seven dollars a bundle. Once, Christmas trees were so scarce in one eastern city that people paid fifteen dollars for a single tree. At the same time, another city had such an oversupply that nearly sixteen carloads had to be disposed of by burning. The day after Christmas, the evergreen market is dead. Whatever profits Vahlsing and his fellow dealers make must be obtained in the few days of feverish activity just before December 25.

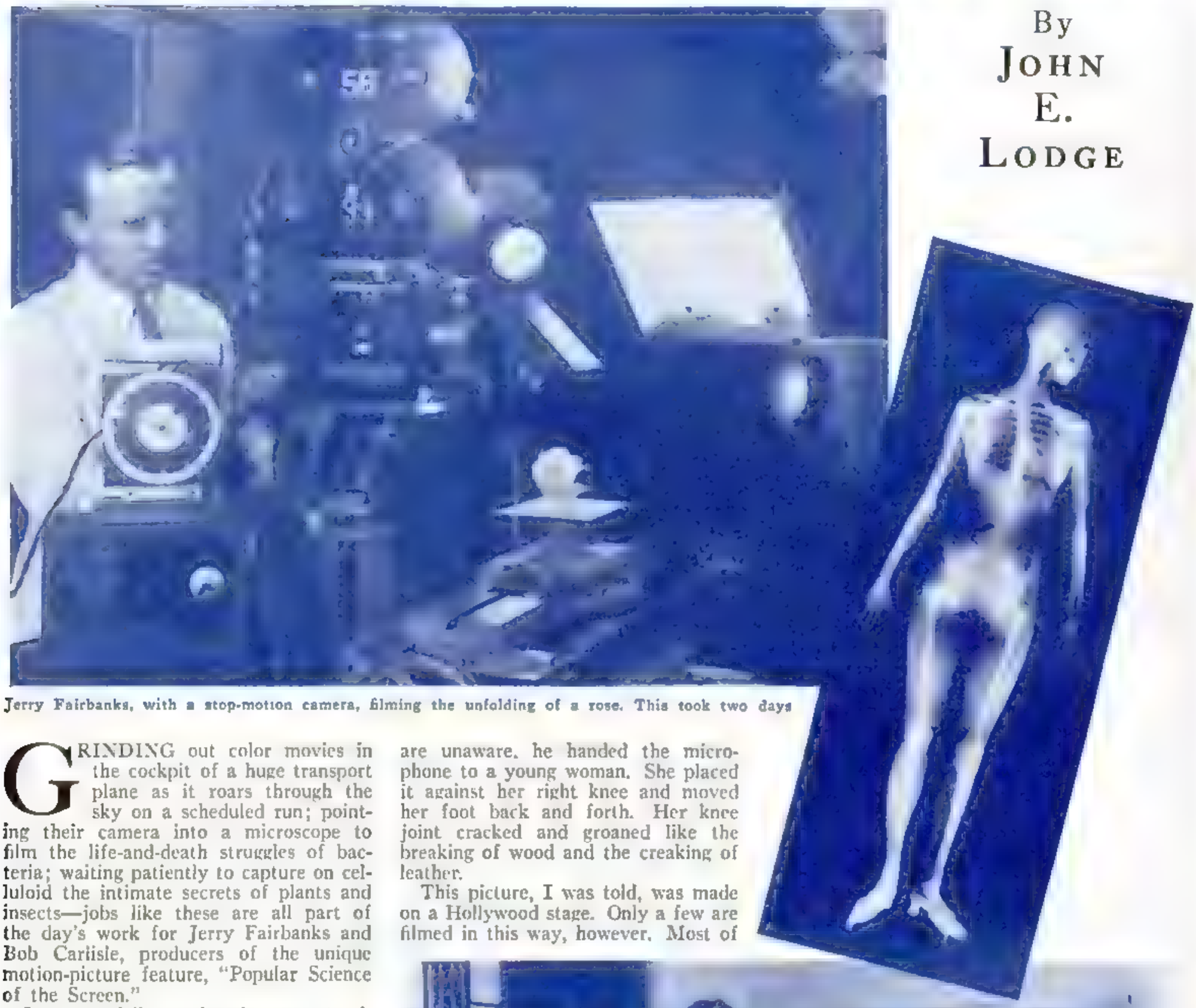
The age of the average Christmas tree they sell is six years, and its height is from five to seven feet. The smallest trees sold are one-foot table decorations. The largest are giants, forty and fifty feet high, pur- *(Continued on page 125)*

Probably the biggest Christmas tree ever cut and decorated was this eighty-foot Norway spruce set up last year in Rockefeller Center, New York City. More than a mile of wiring was used in stringing the 1,700 colored bulbs to light it

Historic Faneuil Hall, in Boston, Mass., banked with evergreens from Maine as the yule season changes the famous square into a market for trees. This scene is reproduced all over the nation in the busy week before the holiday

How POPULAR SCIENCE

By JOHN E. LODGE



Jerry Fairbanks, with a stop-motion camera, filming the unfolding of a rose. This took two days

GRINDING out color movies in the cockpit of a huge transport plane as it roars through the sky on a scheduled run; pointing their camera into a microscope to film the life-and-death struggles of bacteria; waiting patiently to capture on celluloid the intimate secrets of plants and insects—jobs like these are all part of the day's work for Jerry Fairbanks and Bob Carlisle, producers of the unique motion-picture feature, "Popular Science of the Screen."

In a specially equipped motor truck or in the cabin of their high-speed plane, they track down new and interesting things in the world of invention and science. With the aid of the editors of POPULAR SCIENCE MONTHLY, they present every six weeks in theaters throughout the world a dozen subjects ranging from full-length X-ray pictures of the human body to microscopic shots of a bee's auxiliary wings.

The other day I sat in a tiny projection room in Hollywood, viewing the latest of these "Popular Science" reels. On the screen flashed a view of an office in which a man was sitting at a desk holding in his hand a round, metal object, a supermicrophone capable of picking up and relaying inaudible sounds. The man placed a caterpillar on the delicate diaphragm of the instrument. The noise of its tiny, padded feet sounded like the beating of a base drum. He struck a match. The sound was like a roaring conflagration. At last, to prove the device "hears" sounds of whose existence we are unaware, he handed the microphone to a young woman. She placed it against her right knee and moved her foot back and forth. Her knee joint cracked and groaned like the breaking of wood and the creaking of leather.

This picture, I was told, was made on a Hollywood stage. Only a few are filmed in this way, however. Most of

Full-length X-ray pictures of the human body were brought to the screen for the first time in color by the use of this apparatus. The shield being placed in front of the X-ray tube varies the intensity of the rays according to the thickness of the body, to give uniformity of exposure

is Put on the Screen

Skillful Directing and Miracles of Photography Bring to Your Theater The Wonders of Nature And Interesting Events In the World of Science

Fairbanks and Carlisle in the fast cabin monoplane they use in running down new subjects for "Popular Science of the Screen." Some of their most beautiful scenes were made from this craft

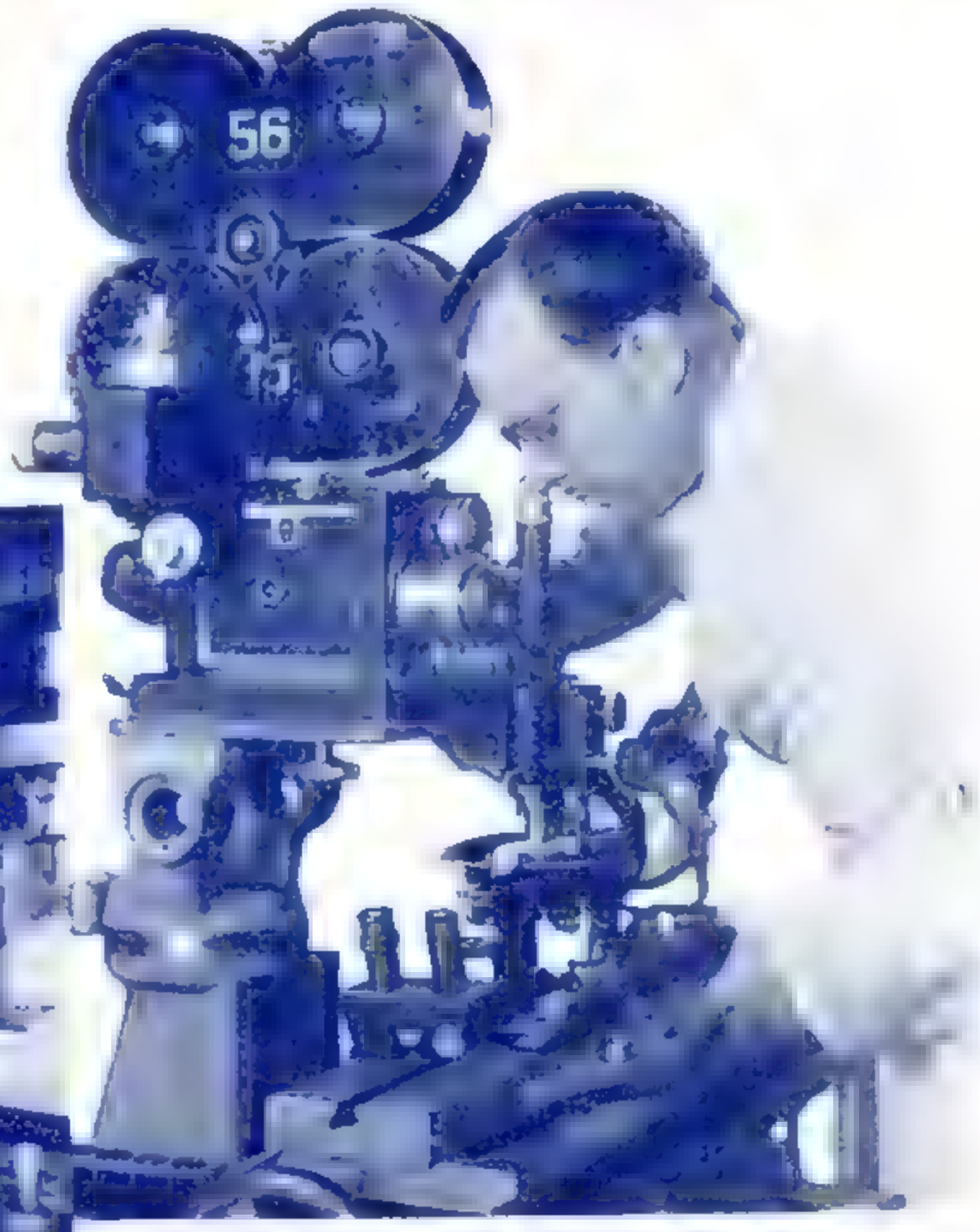
them are recorded in the laboratories and workshops where innovations are actually being produced. To accomplish this, Fairbanks and Carlisle have assembled a complete and mobile outfit that is ready to go on a moment's notice. Their truck is packed with lights and cameras and sound-recording apparatus. It even carries special refrigerators to keep the film in the best condition. This vehicle, like a fire engine, is ready to roll, day or night. If the new development is far from Los Angeles, the producers travel in their high-wing cabin monoplane, kept ready at a local airport. Often, a single release will contain films that were shot at opposite sides of the continent.

Not long ago, when they took the first full-length X-ray pictures of the human body ever made in color, they journeyed all the way to Rochester, N. Y., where Eastman Kodak scientists had developed special apparatus that made the picture possible. Here is how this interesting advance in science was brought to the screen:

Since the human body is much thicker in some places than in others, full-length X-ray pictures in the past always showed the legs and arms overexposed and the torso underexposed. At the Eastman laboratory, research men produced a shield of varying density. It lets more X rays pass through the thicker parts of the body, thus producing an evenly exposed negative. The X-ray machine was placed behind this shield which was adjusted to cover the body of a young woman standing in front of a film contained in a large plate. In making the picture, the producers started with a full, long shot of the girl, made a "lap dissolve," and matched her figure exactly with the finished X-ray photograph already registered on the large film.

Thus, as she stood motionless against the large plate, the audience saw her body gradually disappear and her skeleton become visible. Following this transition, the camera was moved in for a close-up and the procedure was repeated, starting with a picture of her head, which again "dissolved" into an excellent skull portrait.

Since all scenes are photographed in full color, much more light is required than for standard black and white reels. So the producers carry with them a battery of twelve floodlights and reflectors, capable of concentrating 15,000 candle power of light on the scene they are



Here the camera and microscope are combined to give movie patrons an idea of what happens when bacteria develop in a sample of milk

The striking scene at the left, showing hundreds of optical lenses being ground at once, was part of a sequence which traced the glass from the flaming furnaces through all the processes of manufacture

A studio set representing a lady's boudoir, erected for a demonstration of a household appliance. Similarly, a kitchen setting serves for displaying new utensils

shooting. Color, however, gives many subjects added interest because of their delicate shading or brilliant hues. Thus, on the screen, the grinding of optical lenses became a thing of beauty as well as a fascinating scientific process.

At the Rochester plant of the Bausch and Lomb Company, Fairbanks and Carlisle set up their lights and camera directly in front of the blast furnace. Despite the terrific heat, they recorded the molten glass as it emerged from the furnace and sped to the rolling tables, a superb symphony of flaming color. Another shot showed the polishing machines where hundreds of lenses simultaneously receive their final finish. Thus, startling beauty and practical interest were combined in a few feet of film.

Sometimes, one of their pictures can be completed in a few hours. At other times, it requires weeks, or even months, of patient effort.

When news reached them that a scientist at the Scripps Institute of Oceanography, in La Jolla, Calif., was producing pearls more beautiful than those created by nature, they headed south with their lights and cameras. In a single day, they recorded the life history of a synthetic pearl: the capture of an abalone on the seashore, the planting of a bit of the pearly layer of a shell in a surgical incision in the body of the mollusk, the convalescence of the abalone in a temperature-controlled salt-water tank and, finally, the finished pearls in varying colors. By sundown, the picture was "in the can" and they were speeding back to Hollywood.

In contrast, another subject required more than ninety days to finish. It showed the colorful life cycle of a moth.

From a professional grower of butterflies and moths, they obtained several caterpillars which were transferred to cages in the studio. Here they were photographed feeding and spinning their cocoons. Finally, a camera was focused upon one of the cocoons.

"We hoped to get a shot of a moth emerging," Carlisle explained. "Since this occurs almost without warning and is completed in a short time, we worked in shifts. For three days we kept constant watch and at last were rewarded with a magnificent close-up, which covered possibly twenty feet of film."

Much of the work of putting "Popular Science" on the screen is accomplished through high-powered microscopes. To reveal the subvisible world in its natural colors, Fairbanks and Carlisle have assembled one of the most elaborate collections of microscopical instruments in the country.

In one instance, a microscope was focused on a bit of moldy bread. Every two minutes for sixty hours, the camera, controlled by an ingenious clock mechanism, automatically snapped a picture. Eighteen hundred frames, or separate pictures, recorded the full growth of the subvisible fungi.

Another time, the microscopes helped film an interesting scientific advance—mothproof fabrics. Landing their plane at Philadelphia, Pa., the two screen reporters of science assembled their equipment at a plant where the new fabric was being turned out. A shot of whirring looms and another of the laboratory where scientists were at work, established the locale. But the real story lay in scenes that only a microscope could reveal. These showed moths and carpet beetles feeding on multicolored patterns of cloth and ultimately their death from the chemicals the fabric contained. Some of these later shots were made in the Hollywood laboratory, 3,000 miles away, after the producers had flown back to the West Coast.

Their speedy, cream-colored monoplane carries special equipment for filming scenes from the air, and it has helped in recording some of their most striking pictures.

On one occasion, they installed a battery of powerful lights in the cabin of a huge transport plane and filmed the pilots and instruments to reveal the secrets of control during a scheduled flight. These interior shots showed the pilots taking off, reading the instruments, talking on the radio, flying through fog, and landing. Views supposedly taken through the windows of the cockpit showed the machine plunging into a mile-high bank of fog for a blind flight. These last shots were really made from the producer's monoplane as it maneuvered through fog over the San Fernando Valley in southern California.

A dramatic scene: the opening of an abalone shell in which a pearl has been grown artificially by a surgical operation

While thrills are not as numerous in their work as in the lives of newsreel cameramen, Fairbanks and Carlisle have met several spine-tingling emergencies.

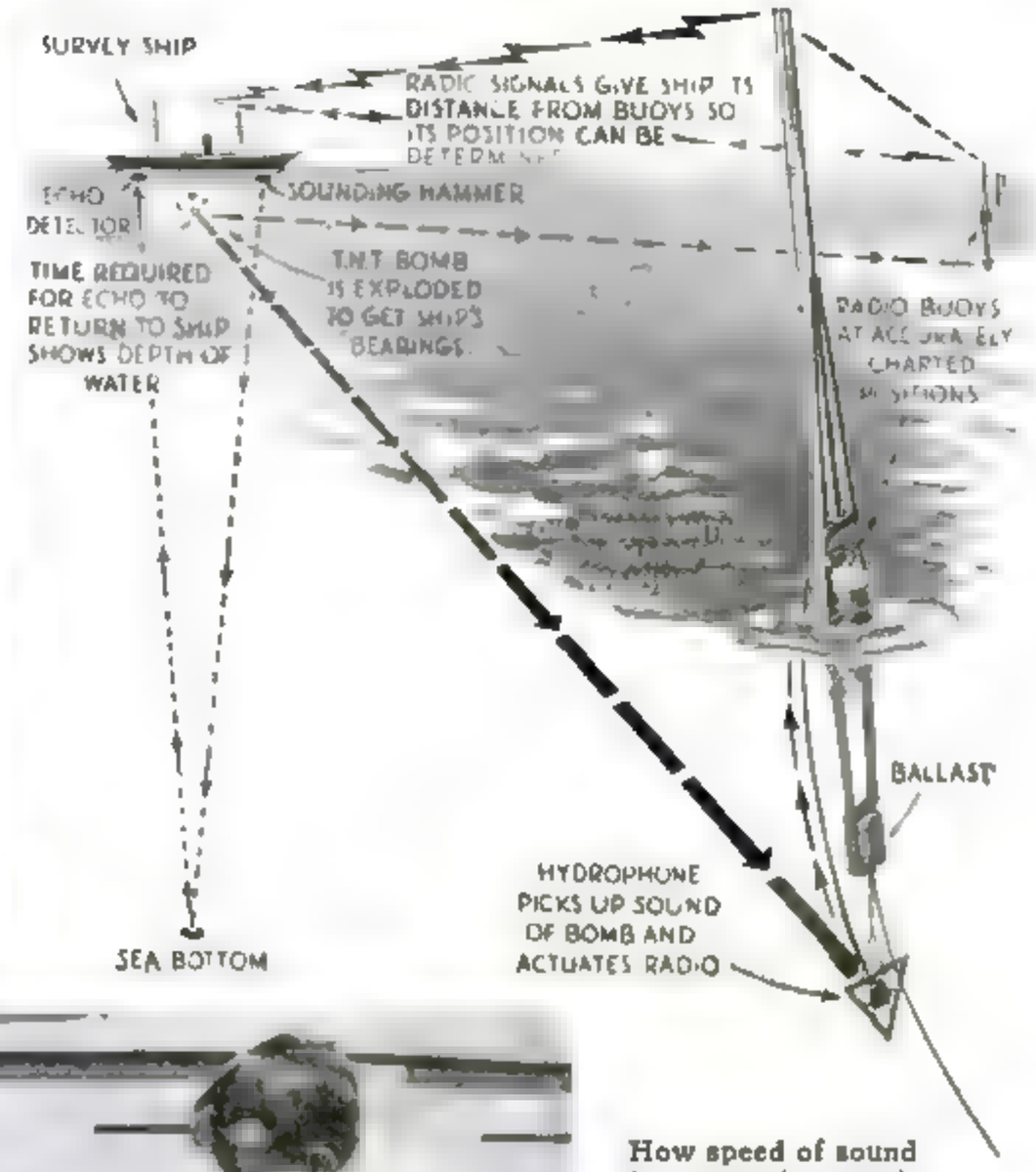
A few months ago, for example, Fairbanks was filming Vance Breese, the famous test pilot, at work trying out a new plane. The final test was a vertical dive beginning at 15,000 feet. Before he climbed into the camera plane, Fairbanks instructed his pilot to follow Breese to 15,000 feet, pace him a short distance, and then so maneuver as to give a good shot of the ship starting on its screaming plunge earthward.

Half an *(Continued on page 131)*

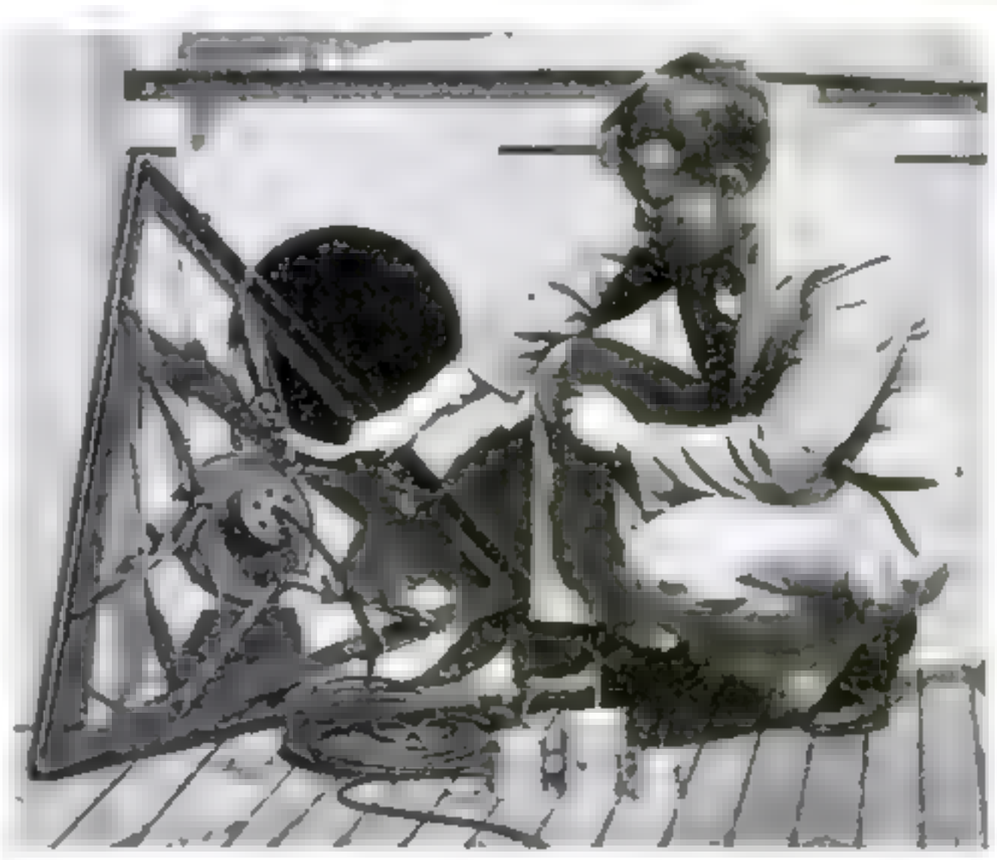
Gayne Whitman, narrator for "Popular Science of the Screen," viewing a reel on a small screen to plan his descriptive talk

Radio Buoys Help Map Coast

Aboard the survey ship, a chronograph tape shows the time interval between the explosion of the bomb and the answering signal sent automatically from the distant buoy



How speed of sound in water gives position and ocean depth



The hydrophone, or underwater microphone, which is fastened to the buoy's anchor cable to pick up the sound of exploding bombs

RADIO STATIONS in oil barrels are helping to make the coastal waters of the United States safer for navigation. Technically known as "sono-radio buoys," they are being used by the U. S. Coast and Geodetic Survey ship *Oceanographer* to fix its position as it charts ocean deeps and dangerous shoals.

To make a sounding, the men aboard this vessel use a speedy and accurate device called a "fathometer," which measures in split seconds the time required for a sound, produced by a mechanical hammer mounted in the hull, to be echoed from the ocean floor and return to the ship. The distance to the bottom can then be gauged accurately, since the speed of sound in sea water is definitely known.

Before the depth can be entered on a chart, however, the exact position of the *Oceanographer* must also be known. The standard method has been to lay a string of buoys about seven miles apart, starting seaward from a surveyed point ashore and then continuing parallel to the coastline for a distance of forty-five miles. So that the buoys can be located on a map, their direction and distance from each other must be measured, and piano wire stretched between them is measured with an ocean-going tape 140 miles long. "Station ships" then anchor at two adjacent buoys in the line to serve as points of reference for the exploring ship, which may be as far as forty-five miles away.

From time to time, the men on the survey vessel toss a T.N.T. bomb overboard. The sound of the explosion travels through the water to the station ships, and its arrival at each one sends back an automatic radio signal to the *Oceanographer*. An automatic timer on the cruising vessel measures the number of seconds between the explosion and each radio response, which spans the intervening distance practically instantaneously. Again the speed of sound in water comes into the calculations, which now show the number of miles to each station ship and thus enable the *Oceanographer's* exact position to be determined.

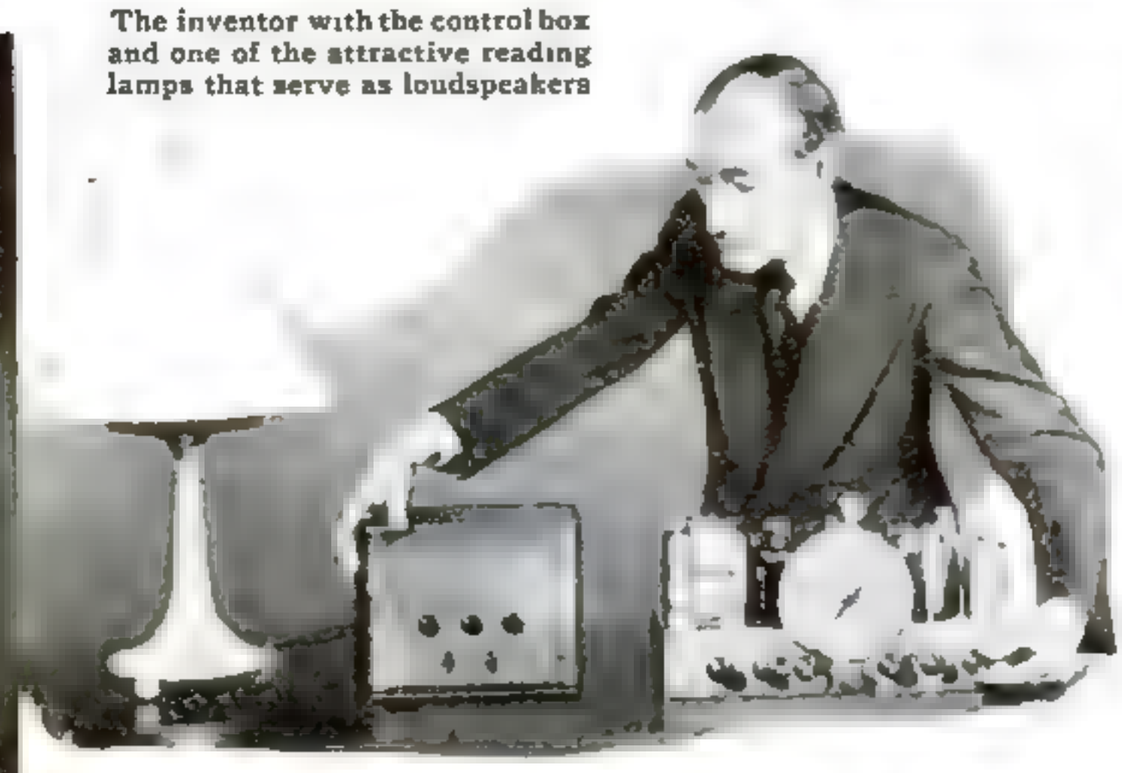
While this procedure has worked satisfactorily from a technical standpoint, it has had one serious drawback. Anchored offshore for ten days at a time, the crews of the small station ships have been endangered by rough weather, and fog has exposed them to the peril of being run down by passing vessels. Now Dr. Herbert Grove Dorsey, of the Coast and Geodetic Survey's scientific staff, has perfected a method that ends these hazards by eliminating the station ships altogether. In their place go the newly perfected "sono-radio buoys" that he has perfected to serve the same purpose.

Operating as a robot radio station, a buoy of the new type employs a transmitter sealed within a floating oil drum, to which a pole and antenna are attached. A hydrophone or sound-detecting instrument is fastened to the buoy's anchor cable and connected to its radio. When the hydrophone picks up the sound of the T.N.T. blast, it automatically actuates the radio transmitter and returns the desired signal. Aboard the *Oceanographer*, the time of the bomb explosion and of the radio signals is recorded by pens on a paper strip resembling ticker tape, in an instrument called a chronograph. Reading this tape, the officer in charge computes the ship's bearings. Since sound travels through sea water at nearly a mile a second, a radio signal received half a minute after the bomb explosion would show that the *Oceanographer* was approximately thirty miles from the corresponding buoy.

Introduced within the last two months, the radio buoys have proved so successful that plans have been announced to use them to rechart the coastline of the entire country. With the resulting maps of submarine hills and valleys, ships will be able to guide themselves far more accurately by taking soundings with a fathometer than is possible by means of astronomical observations.

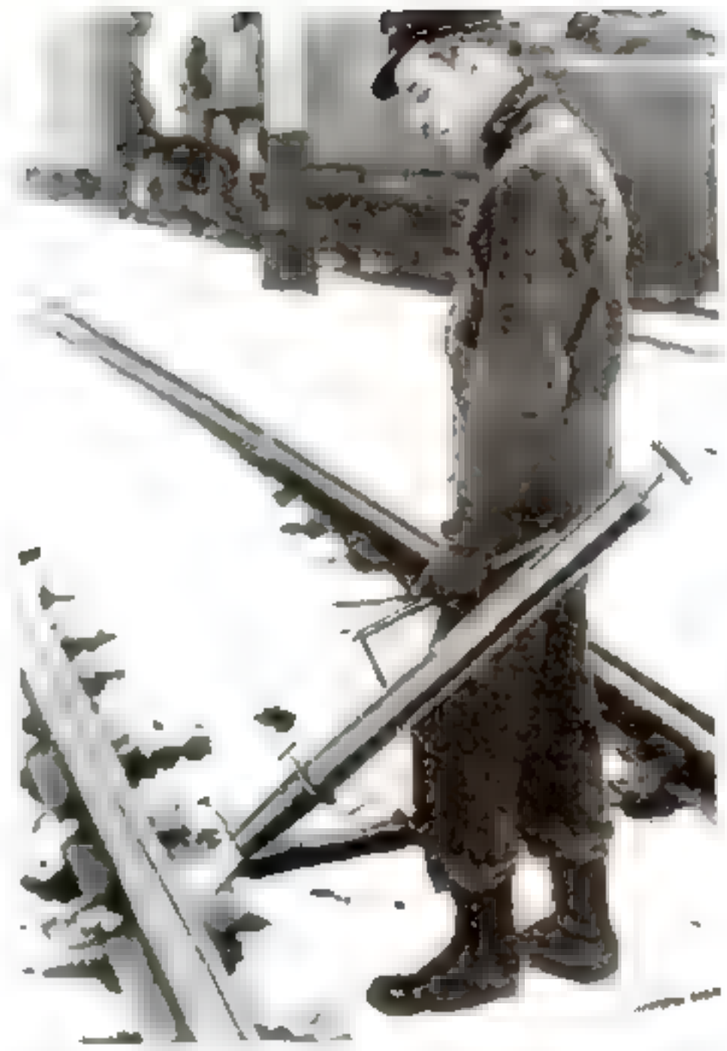
READING LAMPS ARE RADIO LOUDSPEAKERS

The inventor with the control box and one of the attractive reading lamps that serve as loudspeakers



How the lamps are constructed. Plug-in cords make the necessary connections

READING lamps serve as loudspeakers in a new radio unit now on the market. A small control box, which can be connected to any standard receiver, regulates loudspeakers installed in three lamps of different sizes, placed in various parts of a room. Sound is directed from each speaker down through the hollow supporting column of each lamp, and is reflected from floor and walls to blend the musical tones evenly throughout the room. Being in reality three horns of different lengths, the three lamps reproduce the notes in a different range. By regulating the knobs on the control box, the volume of each speaker can be adjusted to give the combined tonal effect desired.



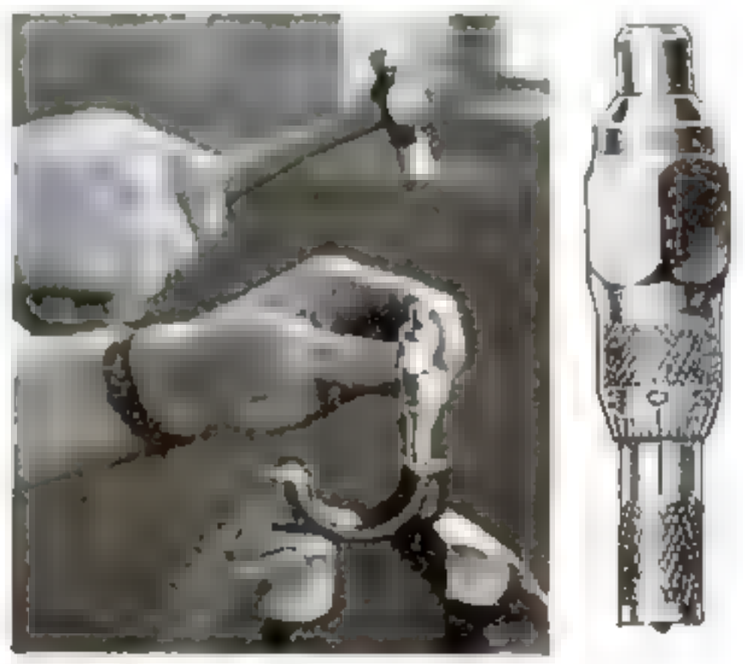
COMPACT GASOLINE TORCH THAWS FROZEN SWITCHES

FROZEN railway switches are quickly thawed with a new portable gasoline blowtorch. Consisting of a tubular pressure tank with a hand pump at one end and a coil burner at the other, the apparatus will burn more than two hours on less than a gallon of gas.

MACHINE BAKES FLAPJACKS ON ROTARY GRIDDLE

FLAPJACKS are baked at the rate of 500 an hour on an automatic griddle recently introduced. Batter is poured by a dispensing jet onto a slowly revolving griddle, and a mechanical flipper turns the pancakes over when one side is brown. After one minute of cooking, another arm lifts the cakes from the griddle and stacks them on a plate. Designed especially for use in hotels and restaurants, the machine has a warming unit in the center to keep the cakes hot until served.

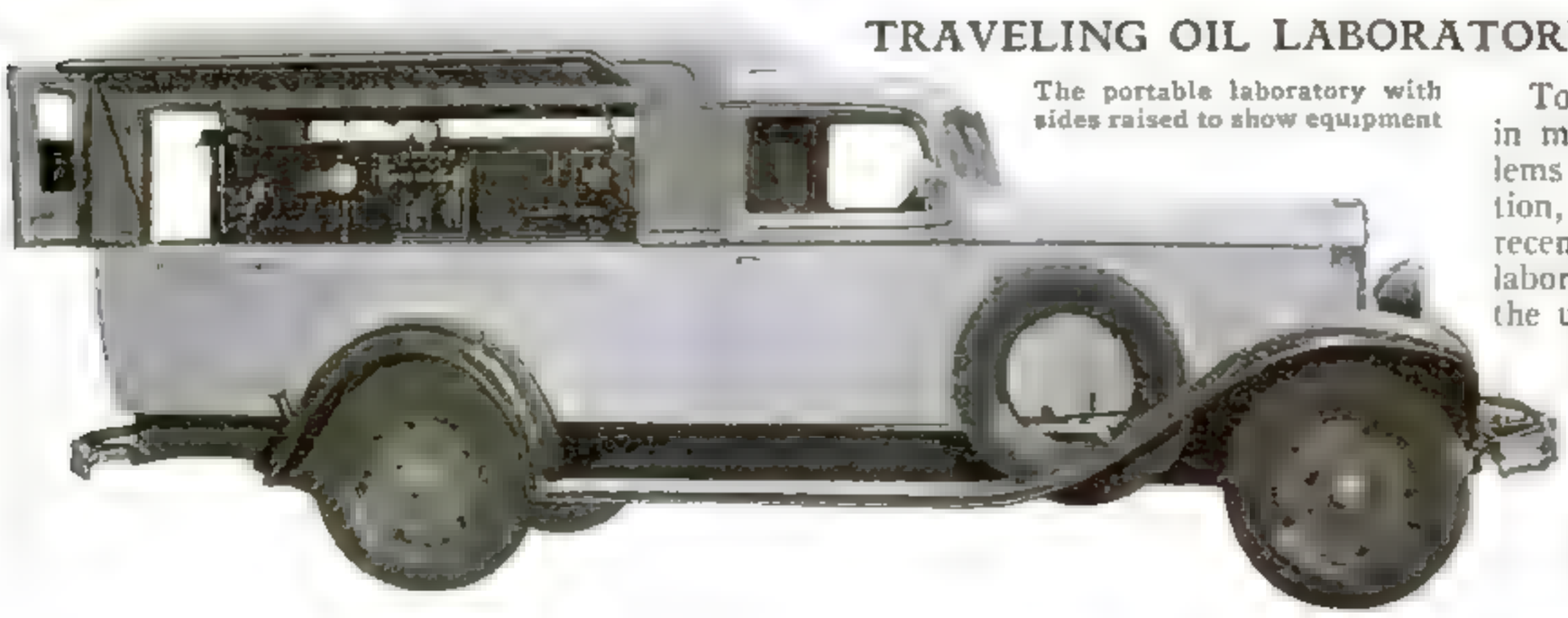
Mechanical hands turn and stack the flapjacks on this griddle



ACCURATE DEPTH PUNCH AIDS IN FILING METAL

METAL surfaces can be filed to a desired depth quickly and accurately with the aid of a micrometer punch devised by a Utah mechanic. The micrometer tool is simply set at the required depth, and tapped with a hammer. When the resulting punch marks are filed away, the metal part is reduced the required amount.

TRAVELING OIL LABORATORY VISITS FACTORIES



The portable laboratory with sides raised to show equipment

TO HELP engineers and mechanics in manufacturing plants solve problems of bearing design and lubrication, a California oil company has recently completed a mobile testing laboratory. Various test bearings in the unit are so connected to motors and meters that the action of lubricants can be studied. By varying the operating conditions, the engineers can duplicate actual problems and determine which bearing design and lubricant will give best results.

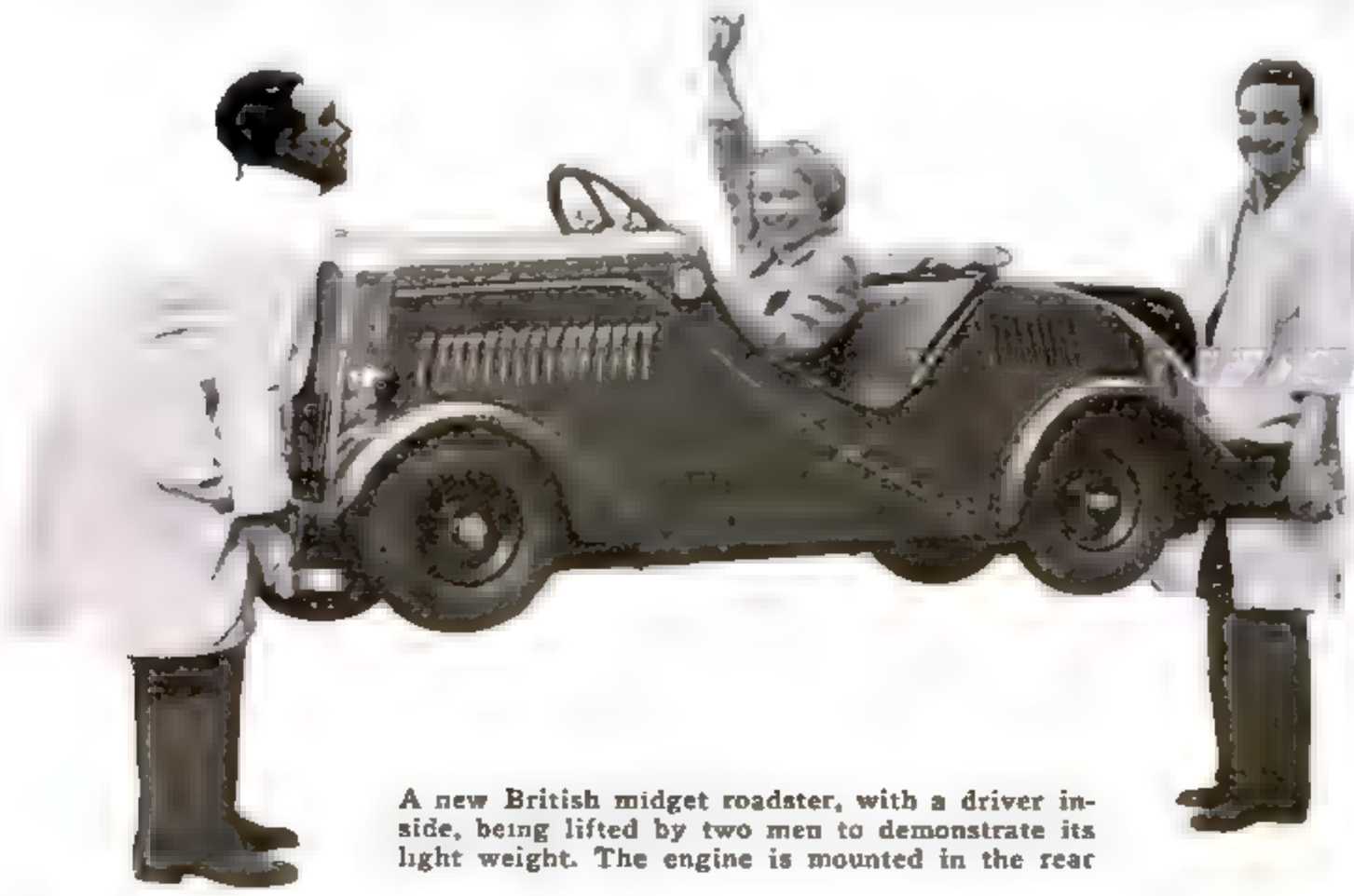
Longest Auto Race Track Has Novel Design

Plan of the new four-mile automobile race track at Westbury, Long Island, N. Y. The mammoth grand stands front on the three-quarter-mile straightaway

WINDING tortuously over its four-mile length, an elaborate new auto speedway at Westbury, Long Island, N. Y., is the longest inclosed track in the world. Constructed so that all parts of the course are visible from every seat in the mammoth grand stands and bleachers, the macadam-covered track consists of twelve straightaways and sixteen curves. At the end of the longest straightaway, a safety chute banked with hay is provided for cars unable to negotiate the first turn. To prevent pile-ups, a system of traffic lights controlled by observers in towers placed at strategic points makes it possible to warn drivers of accidents farther along the track. Giant loudspeakers broadcast the progress of the race, while eight score boards indicate the positions of the cars at each lap. The stands have a seating capacity of 60,000, but 200,000 trackside spectators can be accommodated. According to present plans, the track is to be used for two big races a year.

PATHS ARE ROADS FOR TINY CAR

WEIGHING only 400 pounds, a roadster just introduced in England is small enough to run on any road or path three and a half feet wide. The miniature car has an extremely low center of gravity and runs at a top speed of forty-five miles an hour. Said to go eighty miles on a gallon of gas, the diminutive auto has its engine in the rear to allow ample leg room for its two passengers. The builders claim the car can negotiate fast turns without overturning.



A new British midget roadster, with a driver inside, being lifted by two men to demonstrate its light weight. The engine is mounted in the rear

PERFUME IS CHARGED LIKE SODA

Carbonated toilet water fizzes out when lever is pressed

A NOVEL aid to feminine beauty is a perfume atomizer in the shape of a miniature soda-dispensing bottle. Pressure on the lever attached to the bottle neck releases a fine stream of charged toilet water. The bubbling action of the scented water is said to be very invigorating, as well as pleasant.

"FALSE TEETH" FIGHT CANCER

FITTED over the teeth and gums in the same manner as dental plates, metal molds containing radioactive substances were demonstrated recently at a Chicago hospital as a new means of treating cancer of the mouth. At points where the patient's gums are healthy, the molds are covered with lead to cut off the rays, which are allowed full play on cancerous areas.

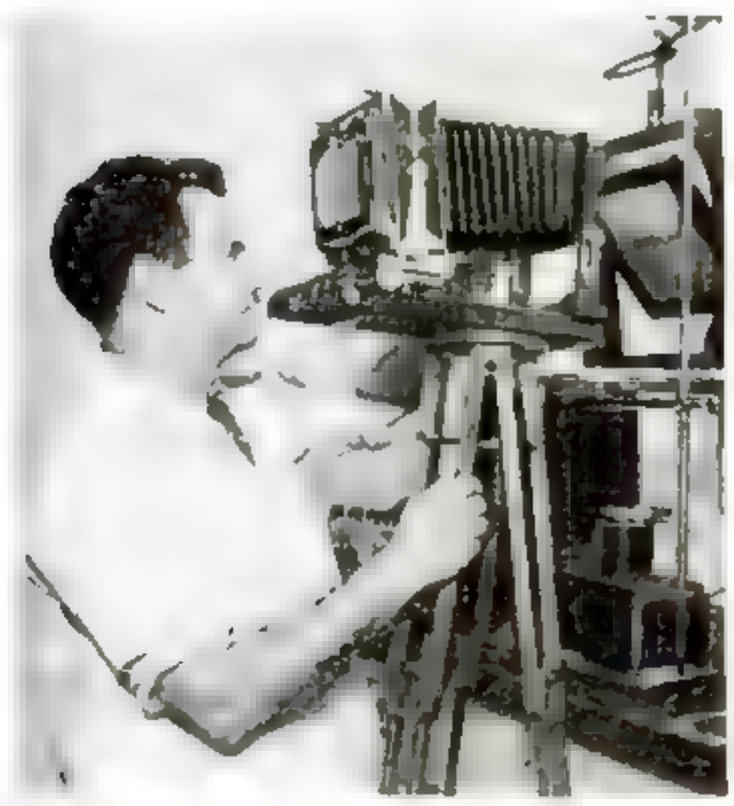
BICYCLE CARRIES ARMY RADIO

Lightweight radio sending and receiving outfits, carried quickly from place to place by soldiers on bicycles, are a feature of Britain's new fast-moving mechanized army. Tested in a sham attack during maneuvers near Hersham, England, recently, the new equipment proved to have an effective range of several miles. The complete outfit, including a loop antenna, is strapped to the back of the operator, who can accompany advancing troops and maintain constant contact with headquarters in the rear. It is also expected to prove valuable in reporting from observation posts.

British soldier with field radio outfit which accompanies advancing troops

"FLIVVER" AUTOGIRO HAS TWO BLADES

CAPABLE of rising almost vertically into the air, a tiny autogiro designed by Juan de la Cierva, Spanish inventor, has only two horizontal rotor blades, instead of the usual four. It is shown here while being demonstrated in England recently. A fifty-horsepower engine is all that is needed for raising and propelling the tiny craft.



CAMERA SHOWS BACTERIA THAT POISON FOOD

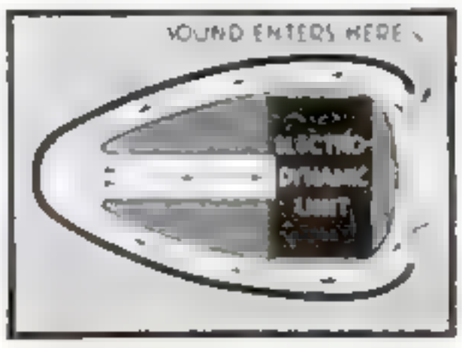
FOOD-POISONING bacteria are detected by the photographic apparatus shown above, developed by the Los Angeles County, Calif., Health Department. Bacteria colonies are planted on a glass disk and given a chemical treatment which causes a transparent zone to appear around the organisms capable of contaminating food. The results are recorded on a film plate.

MINE CAVE-IN DETECTOR

TO PREVENT loss of life in mine cave-ins, a Pennsylvania State College scientist has developed an instrument that detects failure of the overhead rock structure hours before the actual cave-in. Having ample warning, miners can leave in safety.

NOVEL MICROPHONE IS ALSO A REPRODUCER

SHAPED like a bullet, a new electrodynamic microphone is so sensitive that it also can be used as a reproducer, permitting a two-way conversation to be carried on over a distance of 500 feet without batteries or an amplifier. The streamline housing, which eliminates wind effect, makes it unnecessary to employ a wind screen outdoors. The internal construction of the housing, shown in the accompanying diagram, causes the sound to travel a distance twice the length of the instrument before it is picked up by the unit inside.



The unusual design of this microphone, shown in the drawing, makes it remarkably sensitive

Opening a canned oyster which contains an artificially cultivated pearl

CAN HOLDS OYSTER WITH REAL PEARL

THE thrill of finding a pearl in an oyster is assured by a novelty now being marketed for use as a bridge prize or gift. Sealed in a can and covered by a preservative liquid is an unopened oyster in which a pearl has been artificially grown, making pearl hunting a sure-fire matter.

The Man *with the* Net

RAZORS *made of bronze were used more than 3,000 years ago.*

ANTEATERS *walk on their knuckles to protect their claws and keep them sharp for tearing up insect nests.*

SOAP *is being used as a binding material in the construction of unsurfaced roads in the United States.*

ROSY CHEEKS *are not always a sign of good health.*

RABBITS *are extremely sensitive to colored light, thriving under some hues and growing weak and sickly under others.*

BIRDS *require only two ounces of body fat to supply enough energy for a 2,000 mile flight.*

HAWAII'S *average temperature has been increasing every year since 1925.*

OUR EYES *record eighty-seven percent of all the impressions received by the human body.*

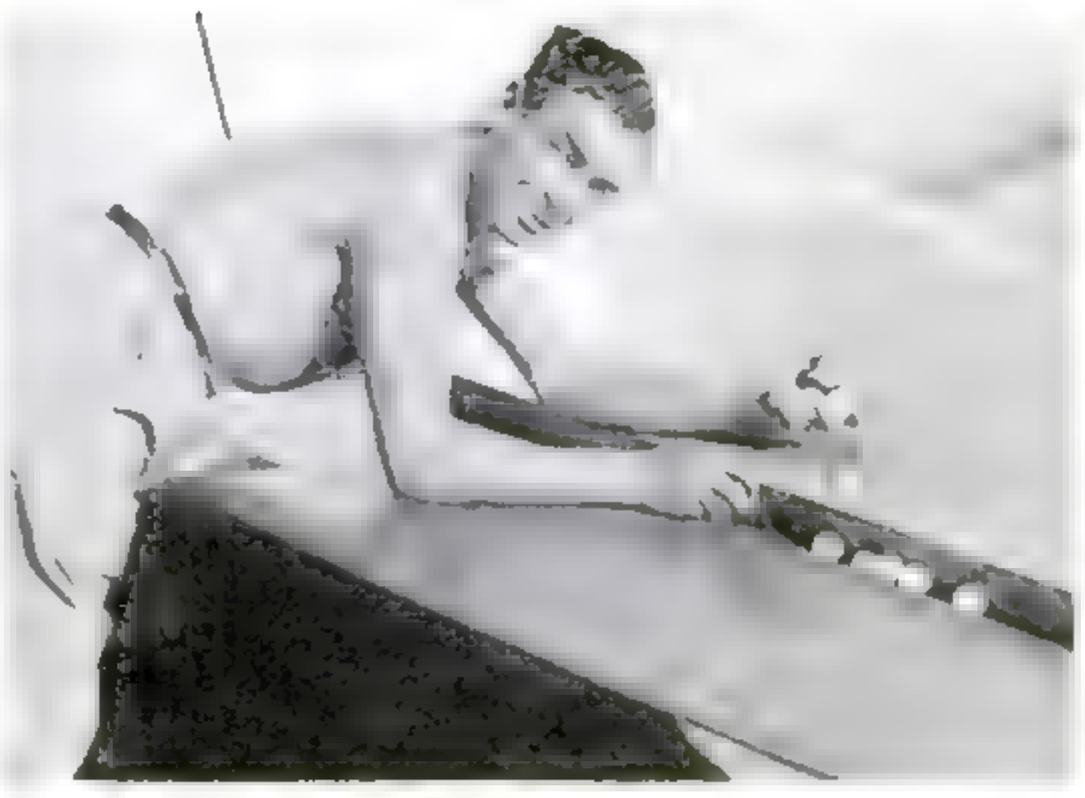
ANTS *outnumber any other single species of animal life.*

PIGS *are now being raised in the arctic by the Eskimos.*

HUMMING BIRDS *prefer purple flowers. Artificial blooms, each holding the same amount of sugar solution, were recently placed near humming birds. The birds came to the purple flower most often.*

ELECTRICITY TREES *in central India carry enough current in their leaves to shock a person and to influence a compass needle.*

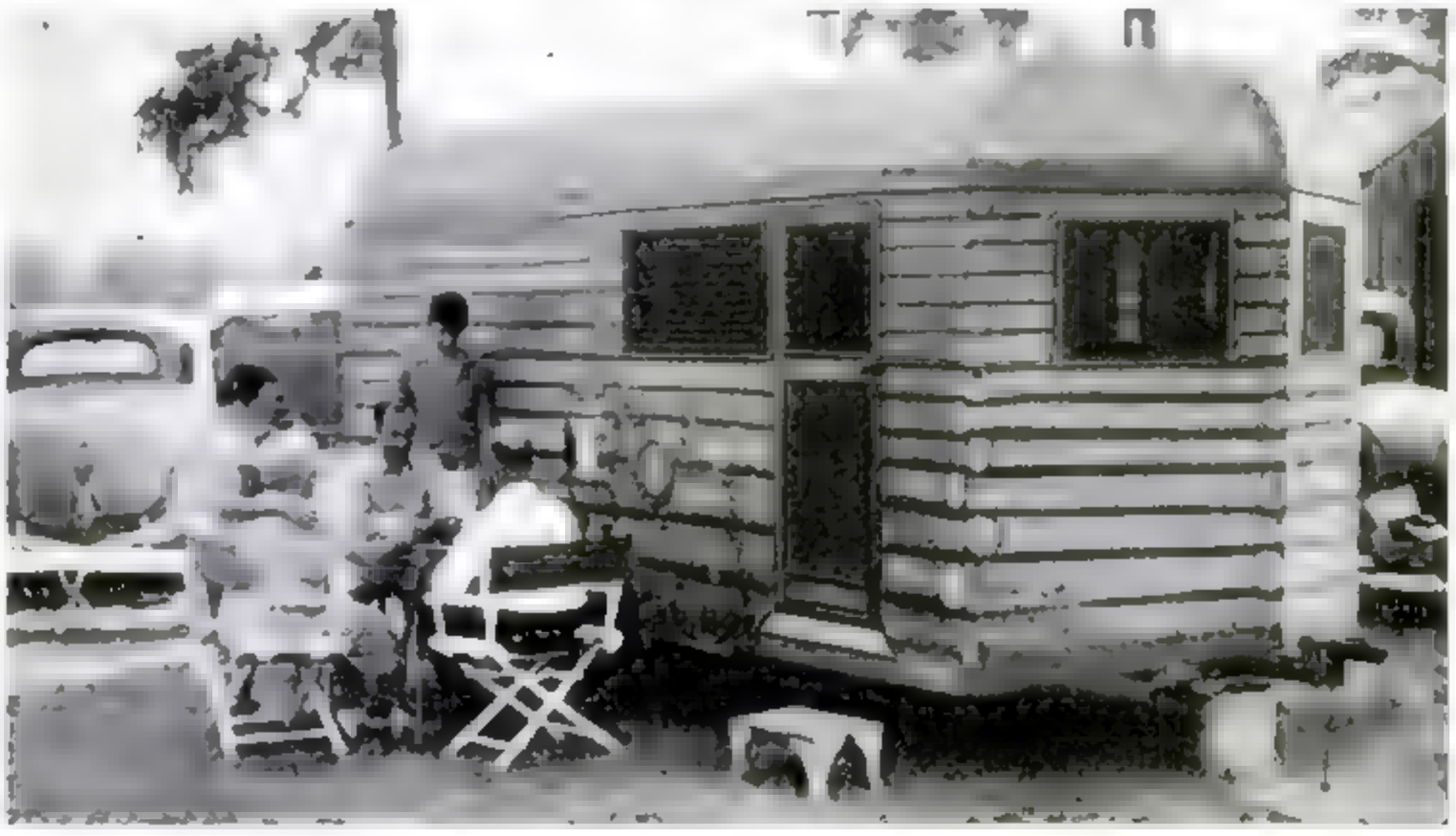
BALLS GIVE BUOYANCY TO OCEAN PLANE



Transatlantic flyer stuffing his plane with table-tennis balls

TABLE-TENNIS balls made their debut as a safety aid for aviators when two American flyers recently stuffed them into the hollow spaces of their craft's wings and tail, in preparation for a round-trip transatlantic flight. The feather-weight celluloid spheres added less than thirty pounds to the plane's total weight, and, the airmen reasoned, would provide sufficient buoyancy to keep them afloat in case they were forced down while at sea.

"LOG-CABIN" TRAILER IS REALISTIC



With its painted logs, flowers, and doorstep, this trailer has an unusually homelike appearance

BY PAINTING his trailer in imitation of a log cabin, Kenneth Balthasar, of Toledo, Ohio, applied a novel touch of decoration to his mobile living quarters. The curving top of the vehicle suggested a thatched roof, and the amateur artist completed his unusual paint job by adding colorful shrubbery, a strip of lawn, and a make-believe doorstep almost realistic enough to mislead a late homecomer.

NEW SKATES FOR USE ON LAND

FANCY SKATING on dry land is made possible by roller skates of a type now gaining popularity in France. The curving face of a blade resembling an ice skate bears a single row of seven tiny roller bearings. By rocking the feet and shifting the weight, greater freedom of movement is obtained than with conventional four-wheeled roller skates, and intricate figure skating can be done.

Expert performers doing fancy skating on dry land. They are using a new-type skate which has tiny roller bearings set along the face of the blade

Garden of Drugs GROWS RARE MEDICINAL PLANTS

By Walter E. Burton

Dr. Franklin J. Bacon, one of the experts at the drug garden of the Western Reserve University School of Pharmacy, near Cleveland, Ohio, examining a row of hyssop plants. Hyssop is one of many varieties of mint grown here

Digitalis leaves being cut for use in making pills for treating heart ailments. This garden produces 100,000 such pills a year

ON A FARM near the eastern edge of the city of Cleveland, Ohio, is a garden that may go down in history as having played an important part in the improvement of an age-old science. This plot of growing things, which looks no more impressive than the average back-yard bean patch, is expected to influence the health of the nation to an immeasurable extent. Already it has been instrumental in prolonging or saving thousands of human lives, and in enabling a great hospital system to chop thousands of dollars a year from its operating expenses.

This strange plot of ground is the drug garden of the Western Reserve University School of Pharmacy. It is the hub about which revolves a program of research in the growing, processing, and use of medicinal plants, and the developing of synthetic substitutes for useful drugs whose source hitherto has been growing plants. Faculty members and students under the direction of Edward Spease, dean of the School of Pharmacy and directing pharmacist of the University Hospitals of Cleveland, are investigating the effects of soils, time and methods of seeding and transplanting, harvesting operations, methods of drying, fertilizers, and other factors bearing on the amount and potency of medicinal substances in plants commonly used in pharmacy.

The story of the drug-plant garden really begins with a dandelion patch that Dean Spease planted some years ago in front of the pharmacy building at Western Reserve. There was a plot of ground in which, largely because of shade and worn-out soil, grass and other desirable plants would not thrive. So he got the idea of setting out some plants that are used in the manufacture of medicines. This, he believed, might attract the attention of the public to pharmacy; and the science of pharmacy just then was in the need of some attention. He selected dandelions as the principal plants because their roots are used in medicine, and because they will grow in shade. He erected a sign bearing the words *Taraxacum officinale*, the scientific name of the weed; and he kept the flower stems, by which most people identify the dandelion, clipped off. The result was that people began to take notice, wonder what a *Taraxacum* is, and to awaken to the fact that there are such things as drug plants.

One man who took notice was Andrew Squire, a wealthy Clevelander who owned a large farm east of the city, and who was a University trustee and chairman of the School of Pharmacy committee. In time, Squire made part of his farm

Relief for victims of heart trouble. A technician making pills and tincture from dried leaves of digitalis

Left, the root cellar at the drug farm. Here drug roots and plants are stored after harvesting, until they are needed for use in experiments or manufacturing

A Visit to a Strange Farm on Which Patches of Innocent-Looking "Weeds" Conceal Cures For Many of the Ills That Beset Human Life

available for the cultivation of drug plants; and when he died less than two years ago, he willed the several hundred acres to the University, thus making certain that there always would be facilities for the cultivation of medicinal plants. This farm, incidentally, is proving valuable for other educational reasons. It makes an ideal place for research in zoölogy and botany because of the presence of an abundance of animal life and of more than 800 species of North American plants in its wooded areas. Some of the trees on the place were a century old when Columbus discovered America.

Dr. Franklin J. Bacon, professor of pharmacognosy (the part of pharmacology dealing with raw drugs and drug plants), lives on the farm and has charge of its operation. Until he points out the various valuable medicinal plants, the average visitor sees nothing to distinguish this farm from any other. But when it is recalled that in those innocent-looking "weeds" are substances capable of keeping an ailing heart pumping, of relaxing intestinal muscles or dilating the pupils of the eyes, and of relieving pain and saving life in countless other ways, the garden seems to become endowed with an atmosphere of mystery and magic.

The woods look like any other natural collection of trees and shrubs that might be found on a northern Ohio estate; but Dr. Bacon will point out scores of medicinal plants growing among the trees—things like golden seal *(Hydrastis canadensis)*, which looks like just another weed to untrained eyes, but whose roots are so useful in medicine that they retail for several dollars a pound.

Scattered over a sloping hillside bordering the orchard are numerous small trees and shrubs which, on close inspection, are found to be marked with metal tags. Examination of the tags reveals that these plants are sources of some of the best known medicinal substances. There are, for example American and European cascara trees, from whose bark a well-known and widely-used laxative can be made.

The way in which the drug garden serves medical science can be illustrated no better than by the romantic story of digitalis. Leaves of the digitalis plant, or purple foxglove, are administered to ailing people as a tonic in acute heart disease, as a stimulant in circulatory troubles, and as a diuretic to stimulate kidney action. In the drug garden, the medicinal plants are raised on individual plots, one half an acre in size. The rows, all of which extend from one side of a plot to the other, are spaced about *(Continued on page 128)*

A pill-making machine in action. The worker is feeding ingredients into it

Dean Edward Spease, of the Western Reserve School of Pharmacy, inspecting a Mexican datura plant. This is a species of jimson weed used in manufacturing sedatives

A scene in the manufacturing laboratory, where the preparation of drugs is controlled by careful analysis with microscopes and chemical reagents

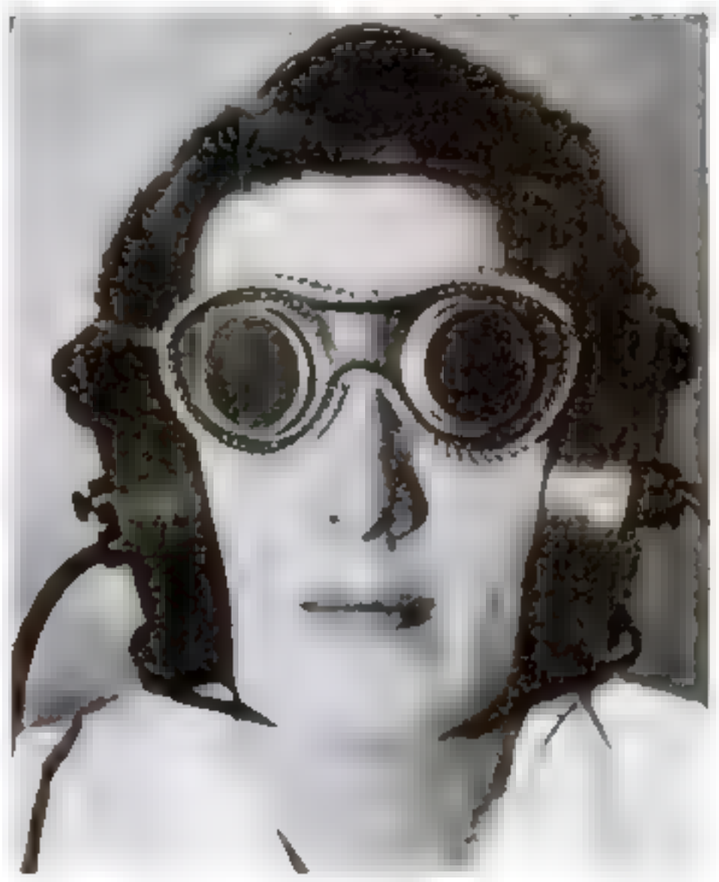
Beavers being transferred from traps to a truck. They will be put to work at erosion control

BEAVERS GET GOVERNMENT JOBS DAMMING HILLSIDE STREAMS

To TURN the dam-building activities of beavers into more useful channels, Federal forest agents in Oregon are trapping the animals in the lowlands, transporting them by truck, and setting them free in mountainous territory to aid in controlling hillside streams. In the lowland farming regions, beavers have caused great damage to crops by damming up irrigation canals, but in their new habitat, the animals are expected to prove valuable in constructive conservation work. The beavers are caught in special wire-mesh traps shaped like traveling bags.

SHORT-WAVE TREATMENT GIVEN BY "EAR MUFFS"

PATIENTS suffering from head ailments that respond to heat are being treated with giant "ear muffs" connected to an ultra-short wave transmitter. Radiating from metal electrodes in the mammoth "headphones," ultra-short waves generate soothing heat in the affected part. The patient wears goggles during the process as protection against the ultra-violet light rays from a mercury lamp which forms a supplementary part of the treatment.



A patient wearing mammoth "headphones" that contain electrodes for ultra-short wave treatments

WIRE BARRIER GATE GUARDS CROSSINGS

If struck by a vehicle, this new railroad-crossing barrier gives enough to stop it gently

PROTECTION for automobiles at railway crossings is provided by a new-type barrier gate just invented. A steel frame straddles the highway and automatically lowers a strong wire barrier across the road whenever a train approaches. If struck by a car, the wire barrier is so constructed that it gives sufficiently to bring the vehicle to a safe, gradual stop. The apparatus may also be installed at dangerous street intersections to operate in connection with traffic lights.

CHICKENS ARE RAISED IN SKYSCRAPER PENS

Eggs are easily gathered from padded troughs into which they roll when laid

GARAGES, city roofs, or apartment-house cellars now can be used to raise chickens, thanks to a unique system recently devised. The birds are housed in compact banks of individual wire cages, supplied with food and water through feeding troughs, and fed cod-liver oil as a substitute for sunlight. With this arrangement, it is claimed, one man can take care of 10,000 chickens, and less than an acre is required for raising 20,000 fowls. Said to keep the birds in exceptional health, the cage system has been installed on the roof of a large New York City hotel to provide its dining rooms with an ample supply of fresh eggs and broilers.

Endless conveyor belts carry waste products from under the cages

ARMORED MOTOR-CYCLE TRACTOR RUNS ON SNOW OR ICE

Our artist's conception of the new war machine in action. It is driven over the snow by a chain belt

SPITTING bullets from its armored side car, a new military motor-cycle tractor just invented skims over snow or ice at high speed. Designed for use in winter or on mountainous terrain always covered with snow, the new war machine has a wide steel chain belt stretched over the motor-cycle wheels to provide traction in deep or packed snow, and on ice. A broad, stubby ski replaces the conventional wheel to support the streamline side car, which carries a long-range machine gun. To protect both driver and machine from enemy bullets as well as from flying ice and snow, a thick plate of heavy armor serves as a front fender and windshield. Steering is accomplished by twisting the front wheel of the motorcycle, thereby warping the steel tread to one side like a sled runner and veering the machine to the right or left.

ONE HAND WORKS SPRAYER FOR DOGS

This spray can be operated with one hand while the dog is held with the other, as shown at left

TREATMENT of skin diseases of dogs is made easy with an antiseptic sprayer of novel design. Made like a perfume atomizer, the device is so constructed that the base and pressure bulb can be held conveniently in one hand, leaving the other hand free to hold the dog. The long spraying nozzle ends in a metal paddle which lifts the animal's hair so that the medication is applied directly to the skin. The paddle may be removed when the sprayer is to be used for treating infections or injuries within the dog's mouth or ear.

TOOTHBRUSH FLOWS WATER ONTO TEETH

A NOVEL toothbrush recently introduced sprays the teeth with water while they are being brushed. Attached to the bathroom faucet, a flexible metal tube carries water to a small nozzle along the back of the brush from which it flows through the bristles onto the teeth. The water spray is said to make the cleaning action of the bristles more effective.

MACHINE DRAWS CURVES TO MATCH COLORS

COLORS are accurately analyzed and matched by a new machine devised by a Massachusetts scientist. Resembling a U-shaped telescope, the device, called a recording photo-electric spectrophotometer, uses lights, prisms, and a photo-electric cell to interpret color as a curve on a graduated wave-length chart. Three minutes after a sample of any colored material is placed in it, the apparatus automatically turns out a chart showing precisely how much of each wavelength of light is reflected by the sample. Thus, each color in the spectrum is represented by its own individual graph curve. If the charts of two samples are identical, their colors are a perfect match. The machine is expected to aid in checking the colors of dyes.

Electric apparatus in use for analyzing color samples. Each shade makes a distinctive graph reading as shown at left

NEW PRESSED COAL KEEPS HANDS CLEAN

DELIVERED in snow-white trucks driven by white-clad drivers, a new furnace fuel just put on the market is so clean that a home owner can toss it into his fire box without soiling his hands or clothing. It consists of fine coal screenings mixed with water and a glucose binder and pressed into 3½-inch cubes. The cubes come in bundles of six wrapped in heavy paper and weighing ten pounds each. The bundles may be used without unwrapping.

From this tower beside the Bay Shore Highway near San Francisco, Calif., police keep a lookout for traffic violators

ROAD POLICE USE TOWER

STANDING GUARD in a roadside watchtower, California police spot traffic violations on the Bay Shore Highway near San Francisco. From the open, elevated deck of the wooden tower, a patrolman has a clear view of the road for several miles in each direction. When a violation is noted, the officer descends a flight of stairs to his parked motor cycle, and speeds off to make the arrest.

A "baby grand" radio cabinet. A slanting control panel replaces the keys

TINY GRAND PIANO IS RADIO CABINET

RESEMBLING a small grand piano, a novel radio set was recently demonstrated at a manufacturer's exhibition in Paris, France. A slanting panel containing tuning and volume controls replaces the usual keyboard, and the loudspeaker is installed beneath the curved, piano-type top. The makers claim that the larger sounding board made possible by the piano shape gives the radio a clearer and truer tone than can be obtained with conventional cabinet sets.

INK WRITES OR PRINTS ON METAL BY ETCHING AND PLATING

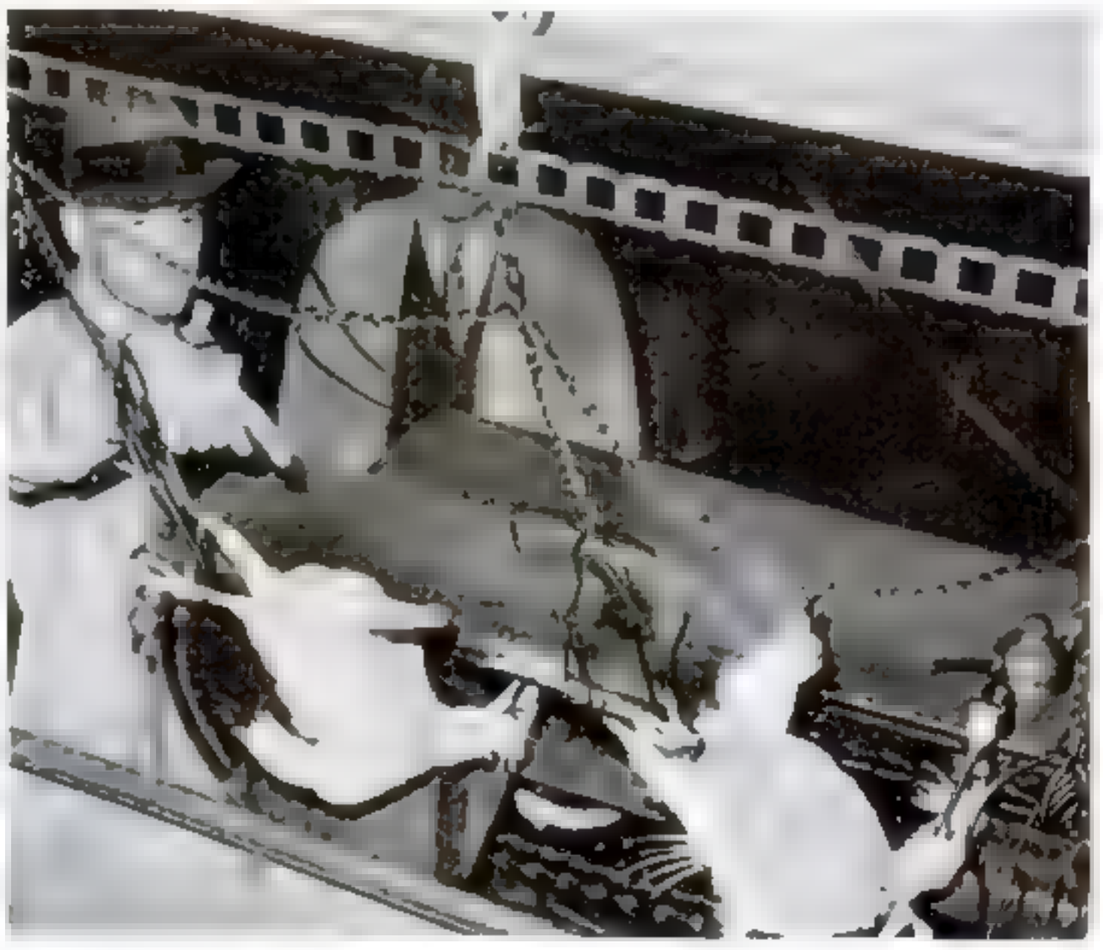
WRITING or printing on metals is made easy by a new ink designed for marking garden tags, machinery, metal containers, name plates, tools, and other metal surfaces. Said to be indelible and weatherproof, it is applied with a special pen, or can be spread on an inking pad for use with a rubber stamp. Harmless to the skin or to fabrics, the ink employs a combined chemical etching and plating action which utilizes the moisture in the air as a fixing agent.

WIND LIGHTS TRAILER

A NEW wind-operated generator makes the electrical system of a motor trailer independent of that of the automobile. Fitted with a twenty-two-inch propeller, the unit is mounted on the front of the trailer and has a capacity of 200 watts. Connected to the trailer storage battery, the apparatus charges at the rate of twenty-five amperes at forty-five miles an hour.

FOWLS ARE ELECTROCUTED FOR MARKET

TURKEYS, chickens, ducks, and other fowl are now killed for market with a new electrocuting machine invented by two San Francisco, Calif., technicians. Suspended from a moving belt, by wire clamps which pinion their legs, the birds are pressed against metal electrodes carrying an electric charge of from 1,000 to 1,500 volts, and are instantly killed. The poultry "electric chair" is said to provide a cleaner, quicker, and more humane way to kill fowl than the usual methods employed to slaughter poultry.



A moving belt thrusts fowls against electrodes carrying high voltage

UNIQUE ROADSIDE GAS STATION RESEMBLES STREAMLINER

Novel auto service station in Cleveland, Ohio, built to resemble a streamline train. Right, an employee dressed like a trainman

MADE from two railroad tank cars and a caboose, a novel auto service station recently opened in Cleveland, Ohio, bears a striking resemblance to a streamline train. Set up on a track and fitted with gas and oil pumps, the tank cars were remodeled to resemble a modern Diesel locomotive, while the caboose was turned into an office and rest rooms. Storage tanks for gasoline are located beneath the track, and the tank cars themselves serve as reservoirs for the supply of motor oil. Automobiles pull up alongside the "train" to replenish their supplies of gasoline, oil, or air. Employees are dressed like railroad trainmen.

SIMPLE GAS MASK USES NO FILTERS

INVENTED by an English surgeon, a new gas mask uses no chemical filters and is said to cost only a fraction of the price of conventional types. A rubber cone, held in place by head straps, covers the wearer's mouth and nose, while a rubber intake tube connects the mask to an air reservoir, resembling an air mattress, which hangs from the user's shoulders and can be inflated with a bicycle pump.

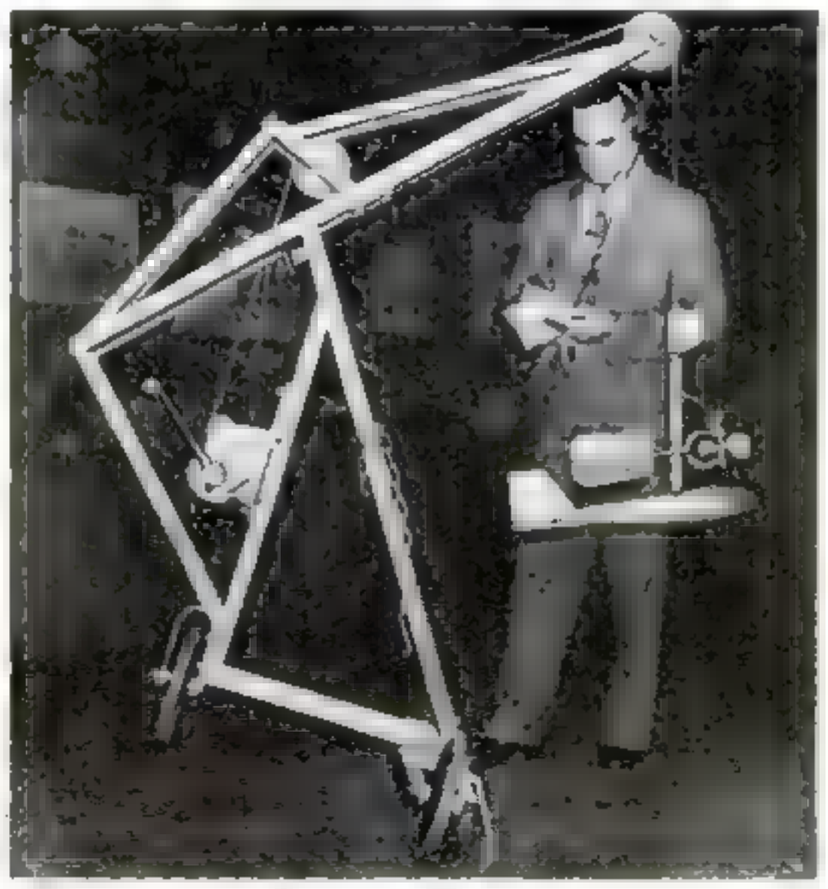
MAKES PHOTO PRINTS IN ODD SHAPES

Movable wings are easily adjusted to any shape

PHOTOGRAPHIC prints in odd shapes are easily made with a handy adjustable mask just placed on the market. Made of a black fiber material, the device measures eight by ten inches and has twenty-nine movable wings which are easily adjusted for making oval, circular, triangular, and other shapes on the finished prints. The mask saves cutting a new vignetting card every time an odd shape or size is desired, and can be used with any method of printing, by either contact or projection.

GAUGE MEASURES FLOW OF RIVERS

SUSPENDED on a cable attached to the hand winch of a small portable derrick, a new electric stream gauge recently invented makes it an easy matter to measure the flow of large rivers. A torpedo-shaped base keeps the apparatus pointing upstream when underwater, while a wheel bearing four hollow cups rotates in the downstream pressure. At each revolution of the wheel, a click is heard in the operator's headphones; these sounds are counted for a definite time period to indicate the speed of the flowing water. With the river's capacity known, engineers can calculate the volume flow of water from the current speed.



Lowered into a stream, this device "clocks" the flow

ELECTRIC-HANDSAW GUIDE SPEEDS BUILDING WORK

A HANDY new guide for electric handsaws enables a carpenter to cut rafters, studding, cross supports, and other structural members quickly and accurately. The guide is mounted on a special worktable built at the job, and the saw slides back and forth in an angle-iron track which can be moved laterally along the work. With the eighteen-pound guide, accurate cuts are easily made at difficult angles. By sliding the saw and guide, rather than moving the work, any number of duplicate pieces can be made at a fast rate. The saw can be readily lifted from the guide for other work.

How-To-Do-It Outfits Mark Trend in Toys

Many Fields of Science and Craftwork Are Opened to Beginners by Novel Kits

ELECTRO-PHYSICS KIT

Instructions and materials for experiments in electricity, magnetism, and physics are included in the outfit illustrated below. A stroboscope (stop-motion device) makes it possible to test the principle of motion pictures

FOR MAKING THINGS OF METAL

With the hammer, molds, and forms supplied in this metal-working outfit, the youthful craftsman can shape book ends, bowls, trays, and many other articles of beauty and utility. Heating torch and shears are included

CHEMISTRY OF RUBBER

Chemical experiments with rubber, such as the making of miniature tires, erasers, and colored rubber, are made easy by the set of materials shown at the right. Supplies of various kinds of rubber are furnished, with the necessary molds and chemicals. An interesting experiment illustrates the process involved in the vulcanizing of rubber for auto tires

GLASS-BLOWING MAGIC. Eighty different stunts with glass are described in a manual that accompanies this novel outfit. A generous supply of glass tubing is furnished, and the equipment includes an automatic alcohol blowtorch

Among the glass-blowing experiments possible are the building of a novel submarine, siphons, and an air gun, as well as several tricks of magic

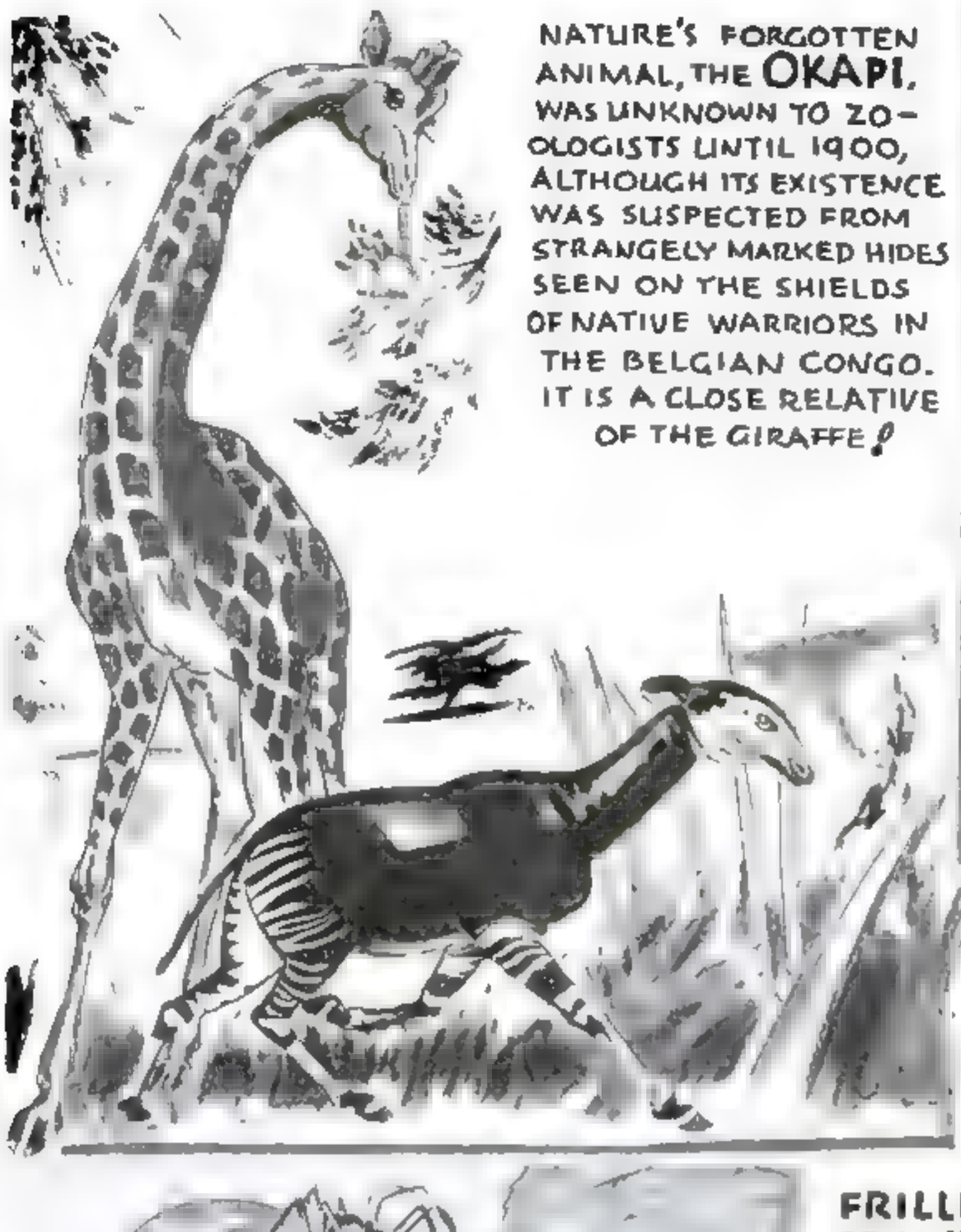
PILOTING A FLYING PLANE. When the remote controls of a new aviation toy are operated properly, a miniature airliner takes off and spirals up around a pylon, gaining speed until it is whirling above the pylon top. Mounted on a universal joint, it can make loops and rolls under skilled hands

KIT TEACHES MINERALOGY

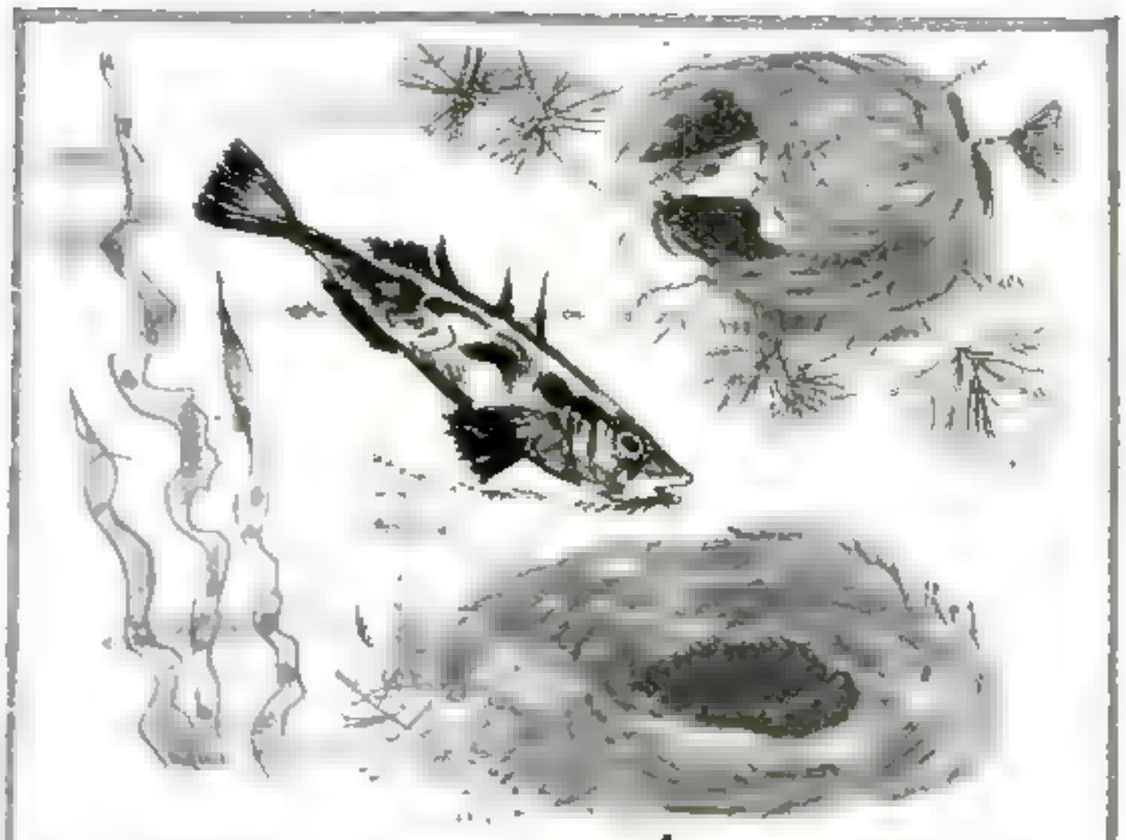
With the outfit illustrated above, the amateur mineralogist learns how to analyze, test, and identify different kinds of minerals. Forty-five samples of rock are included, with all the equipment necessary for making the various tests described. A blowpipe is among the apparatus supplied. In the photograph, a sample is being given a test for magnetism

Un-Natural History

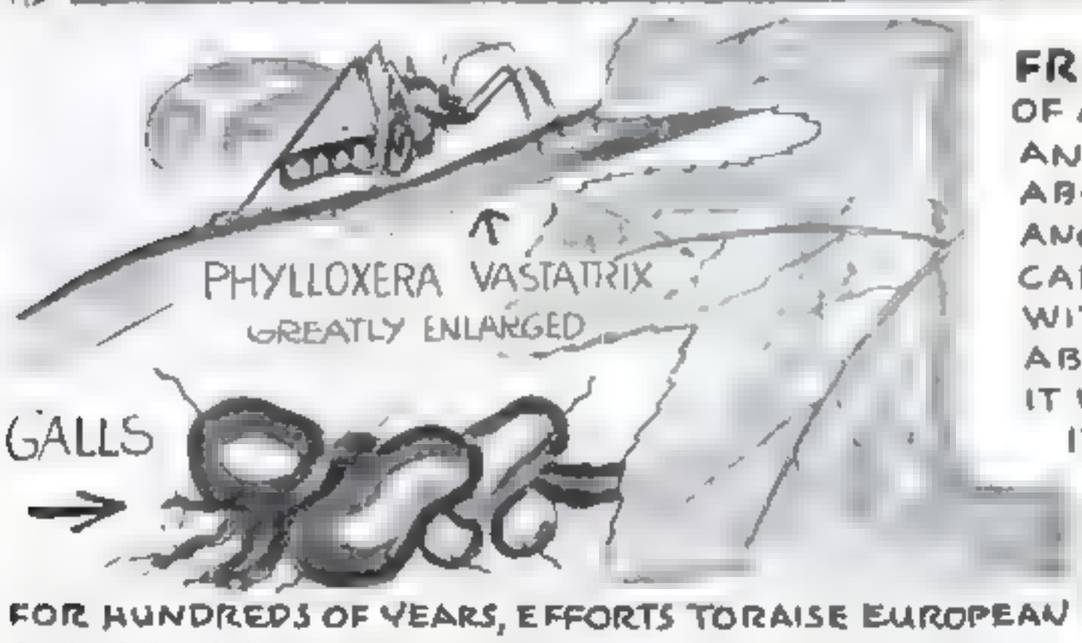
By GUS MAGER



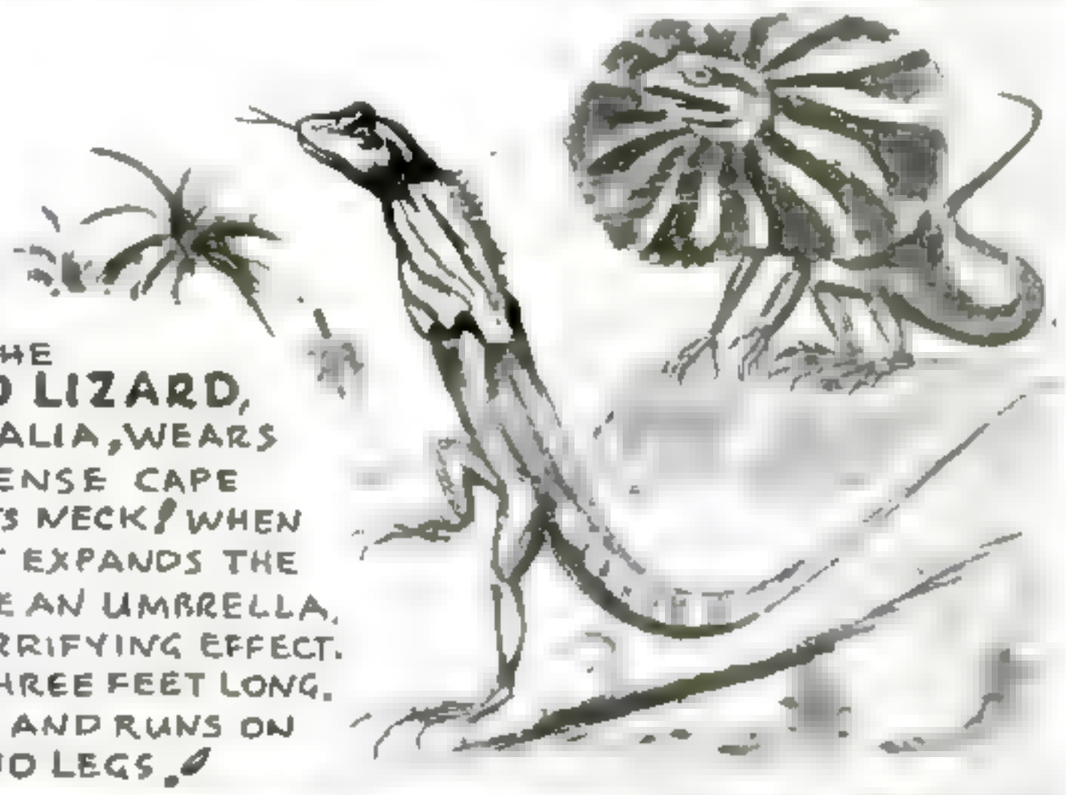
NATURE'S FORGOTTEN ANIMAL, THE **OKAPI**, WAS UNKNOWN TO ZOOLOGISTS UNTIL 1900, ALTHOUGH ITS EXISTENCE WAS SUSPECTED FROM STRANGELY MARKED HIDES SEEN ON THE SHIELDS OF NATIVE WARRIORS IN THE BELGIAN CONGO. IT IS A CLOSE RELATIVE OF THE GIRAFFE!



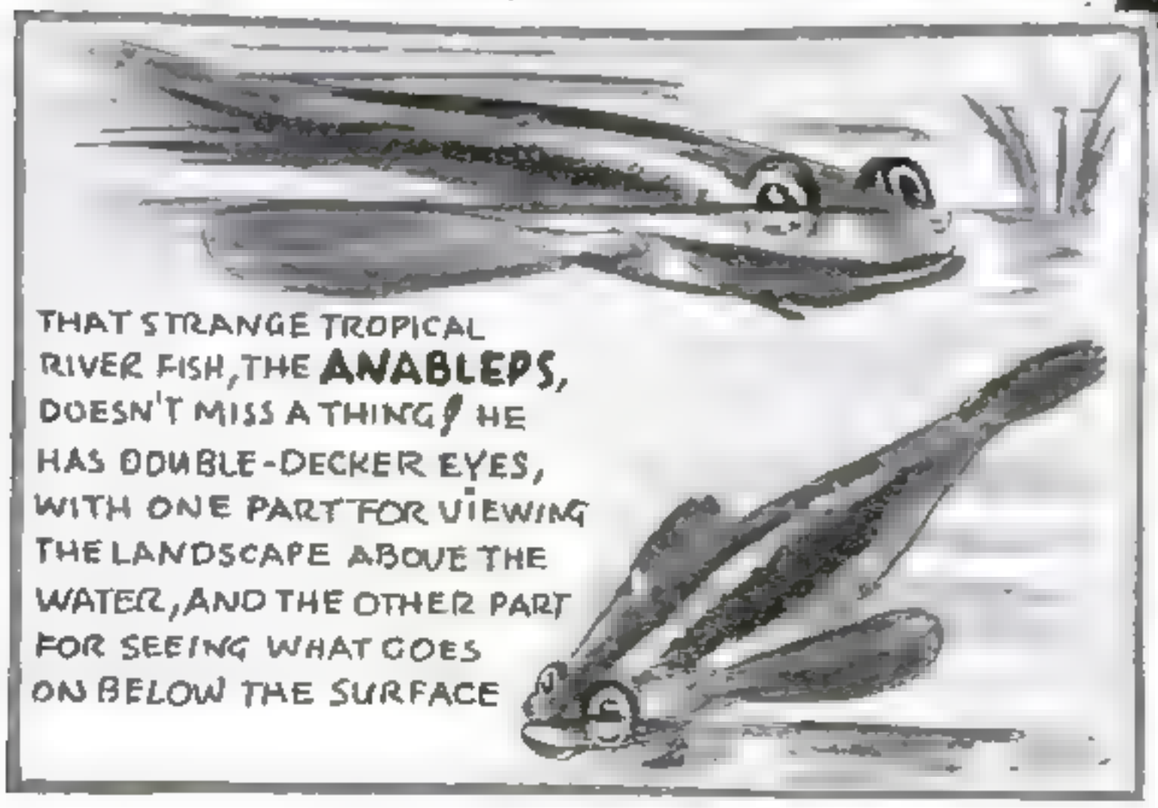
HERE'S SOMETHING VERY CURIOUS! IN ALL THE SPECIES OF **STICKLEBACKS**, THE MALE FISH MAKES A NEST, ENTANGLING LEAVES AND STEMS OF WATER PLANTS AND FASTENING THEM TOGETHER WITH THREADS OF A GLUELIKE SUBSTANCE SECRETED IN THE KIDNEYS!



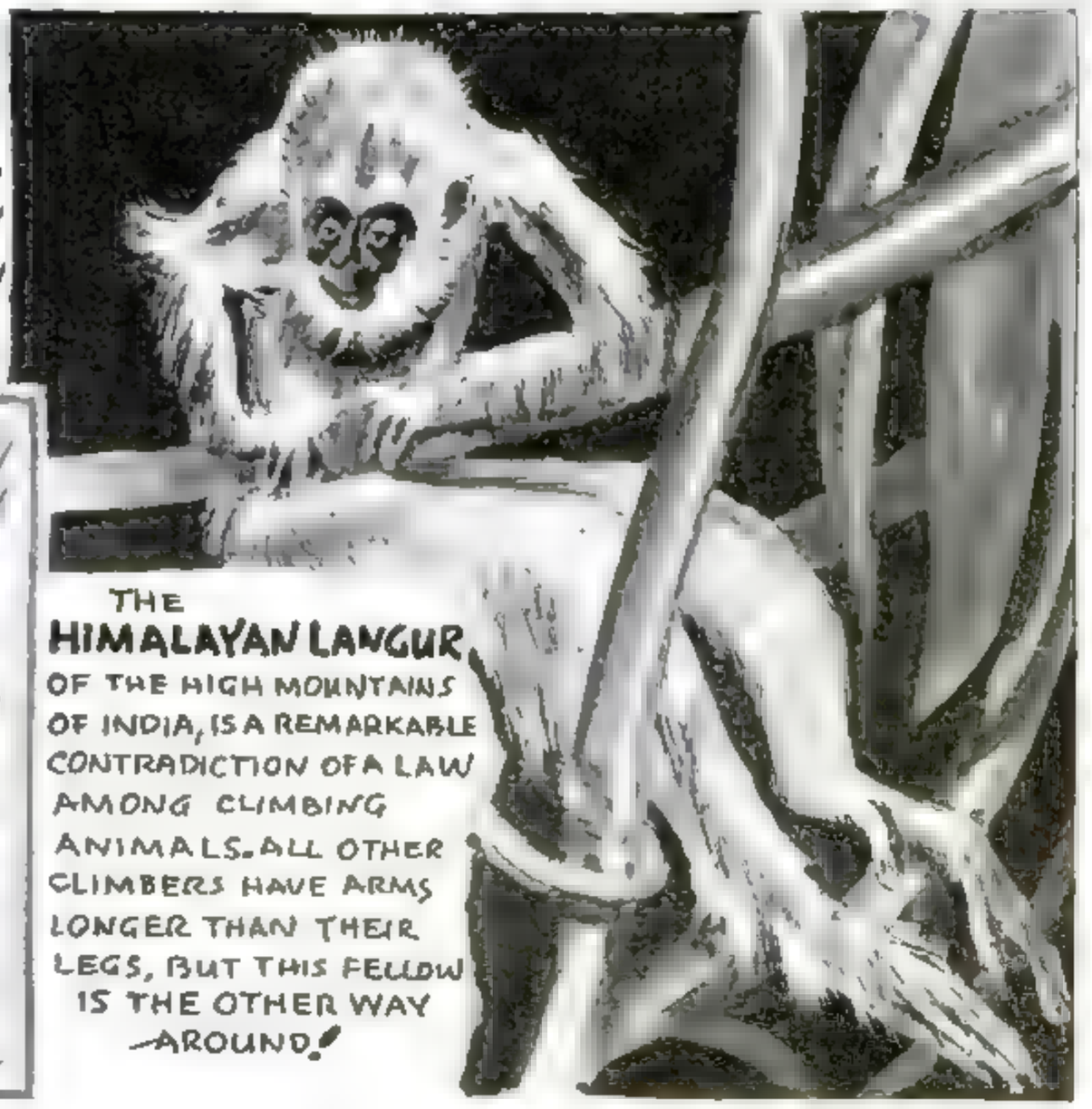
FOR HUNDREDS OF YEARS, EFFORTS TO RAISE EUROPEAN GRAPES IN EASTERN AMERICA WERE UNSUCCESSFUL. FINALLY, IT WAS DISCOVERED THAT A TINY PLANT LOUSE, **PHYLLOXERA**, WAS CAUSING FATAL SWELLINGS, OR GALLS, ON THE ROOTS OF VINES. FOREIGN GRAPES NOW ARE PROTECTED AGAINST THIS PEST BY CROSSING WITH AMERICAN VARIETIES, WHICH ARE IMMUNE TO IT!



THE **FRILLED LIZARD**, OF AUSTRALIA, WEARS AN IMMENSE CAPE ABOUT ITS NECK! WHEN ANGRY, IT EXPANDS THE CAPE LIKE AN UMBRELLA, WITH TERRIFYING EFFECT. ABOUT THREE FEET LONG, IT WALKS AND RUNS ON ITS HIND LEGS!



THAT STRANGE TROPICAL RIVER FISH, THE **ANABLEPS**, DOESN'T MISS A THING! HE HAS DOUBLE-DECKER EYES, WITH ONE PART FOR VIEWING THE LANDSCAPE ABOVE THE WATER, AND THE OTHER PART FOR SEEING WHAT GOES ON BELOW THE SURFACE



THE **HIMALAYAN LANGUR** OF THE HIGH MOUNTAINS OF INDIA, IS A REMARKABLE CONTRADICTION OF A LAW AMONG CLIMBING ANIMALS. ALL OTHER CLIMBERS HAVE ARMS LONGER THAN THEIR LEGS, BUT THIS FELLOW IS THE OTHER WAY AROUND!

Helpful New Tools *for*

DISH-MOP HANDLE HAS SOAP HOLDER

An abundance of sudsy water for dish washing is assured by the use of this mop, which has a rustproof metal container for soap built into its business end

FORK AND SPOON FORM SALAD TONGS. Used separately, the two pieces illustrated above serve as ordinary salad fork and spoon. Fitted together, they make handy scissorslike tongs for serving salad

SLIDE FASTENER LOCKS FOOD BAG
Below is shown an improved refrigerator bag for keeping fruits, meats, salads, and other foods moist and fresh. Made of silk impregnated with oil and a plastic substance, the bag is fitted with a slide fastener for convenience

HOLLOW-GROUND KNIVES FOR CUTTING MEAT

Longer life and superior cutting qualities are claimed for a new type of kitchen and carving knife now on the market. The blade is ground hollow or concave, as seen in the inset. This is said to reduce the necessity for sharpening

SEALERS FOR PRESERVING

Disks of a transparent material afford an easy way to seal glasses of jelly or preserves. They are dipped in water and bound over the top with rubber bands

SELF-DRAINING BACON GRIDDLE

Bacon is cooked without the necessity of draining, on the odd griddle at the right. With it is seen an egg coddler that has individual pans for eggs

the HOUSEHOLD •

HOOKS HOLD CUPS SECURELY. A new-type hook designed for use on cupboard shelves has a spring clip that keeps cups from being knocked off by accident. Slight pressure is all that is needed to snap cup handles into the hooks, or to remove them

WATER MAT FOR HOUSE PLANTS. To protect house plants from the drying out of soil through porous pot walls, a new absorbent mat is placed in a saucer under the pot. Holding water, it keeps the pot walls moist

IMPROVED ELECTRIC DEEP-FAT FRYER

Many of the objectionable features of deep-fat frying are eliminated by the electric appliance illustrated above and at the right. A thermostat controls the temperature to prevent overheating of the fat and assure proper cooking. When not in use, the separate fat container can be placed directly in the refrigerator

OPENS AND CLOSES SCREW-TOP JARS

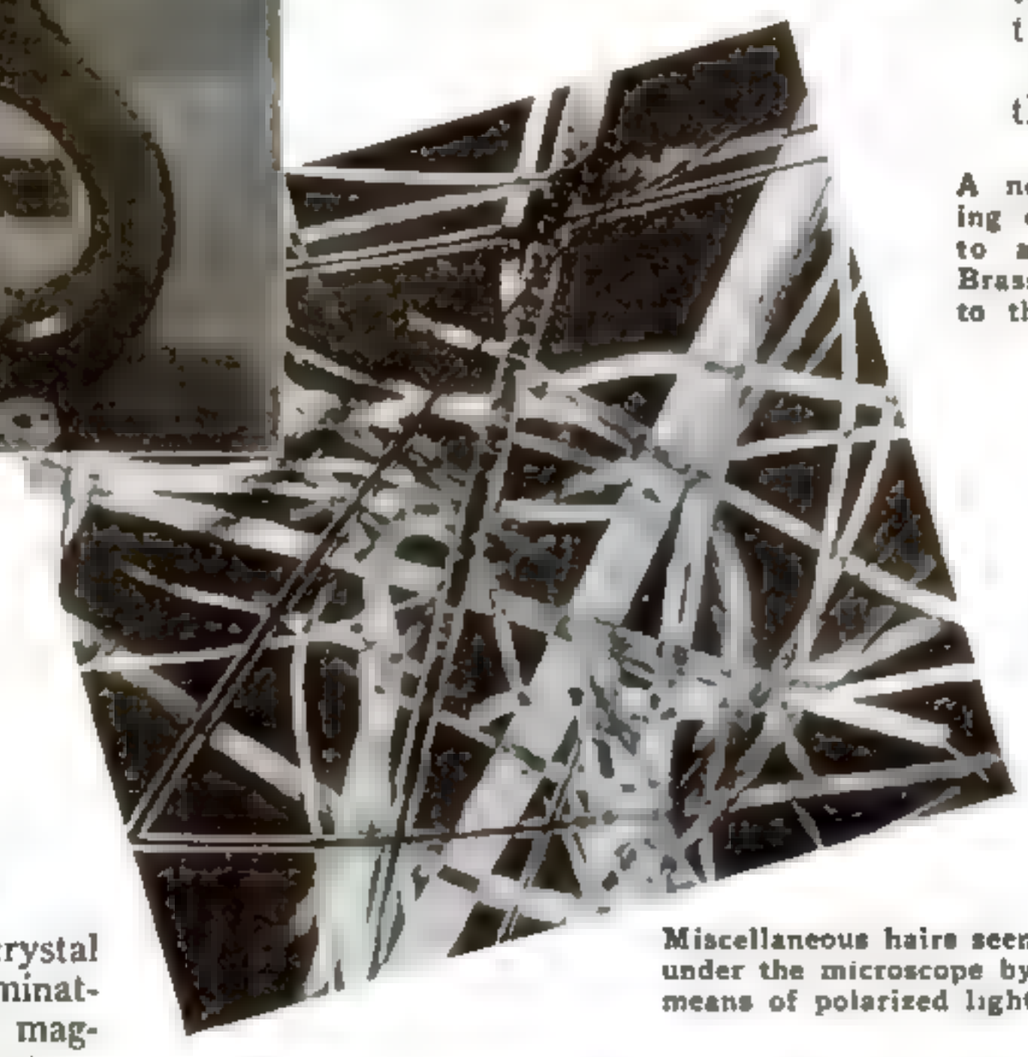
Screw-on tops of containers ranging in size from tooth-paste tubes to fruit jars are turned easily with the adjustable clamp shown below. It also has openers for crown and anchor-type caps

FLOOR LAMP CONTAINS ELECTRIC FAN. Built into the shade holder of this floor lamp is an electric fan which provides circulation of the air. In addition to cooling a room in warm weather, the lamp may be used for heating by the addition of a large bulb at the top of the stand. The shade wholly conceals the fan mechanism

SPLASH GUARD FOR EGG BEATER. Made of moistureproof silk with an elastic edge, this bowl cover has a center hole to admit the shaft of an egg beater. It prevents splashing of food

Equip Your Microscope

A metal jar lid, with a hole in the center large enough to receive the microscope eyepiece, makes a simple holder for a polarizing disk



A new-type polarizing disk being fixed to an illuminator. Brass strips soldered to the light hold it

Miscellaneous hairs seen under the microscope by means of polarized light

By
MORTON C. WALLING

IF YOU have never seen a crystal of potassium chlorate illuminated by polarized light and magnified to about fifty diameters, you still have in store one of the greatest thrills to be found in the fascinating hobby of microscopy. The intermingled play of vivid colors and delicate tints, and the remarkable way in which the details of the crystalline structure are brought out, are things that cannot be described. You may have marveled at the color patterns produced in plant stems and other subjects by the use of specimen stains, but these are nothing to the new beauty you can find in many subjects with the aid of simple polarizing equipment.

Some of the marvels of the polarizing microscope have been described already in this series (P.S.M. Oct. '34, p. 69); but since that article was published something has happened in the field of applied optics that has changed the picture, and opened a way for the introduction of inexpensive polarizing attachments that will increase enormously the capacity of any microscope. This new advance has been the perfecting of a polarizing material in the form of a sheet or plate (P.S.M., Apr. '36, p. 20), which is as easy to use with the microscope as conventional color filters.

But before taking up the methods by which a microscope can be converted for polarizing work, let's take a look at the behavior of light itself, and its action when polarized.

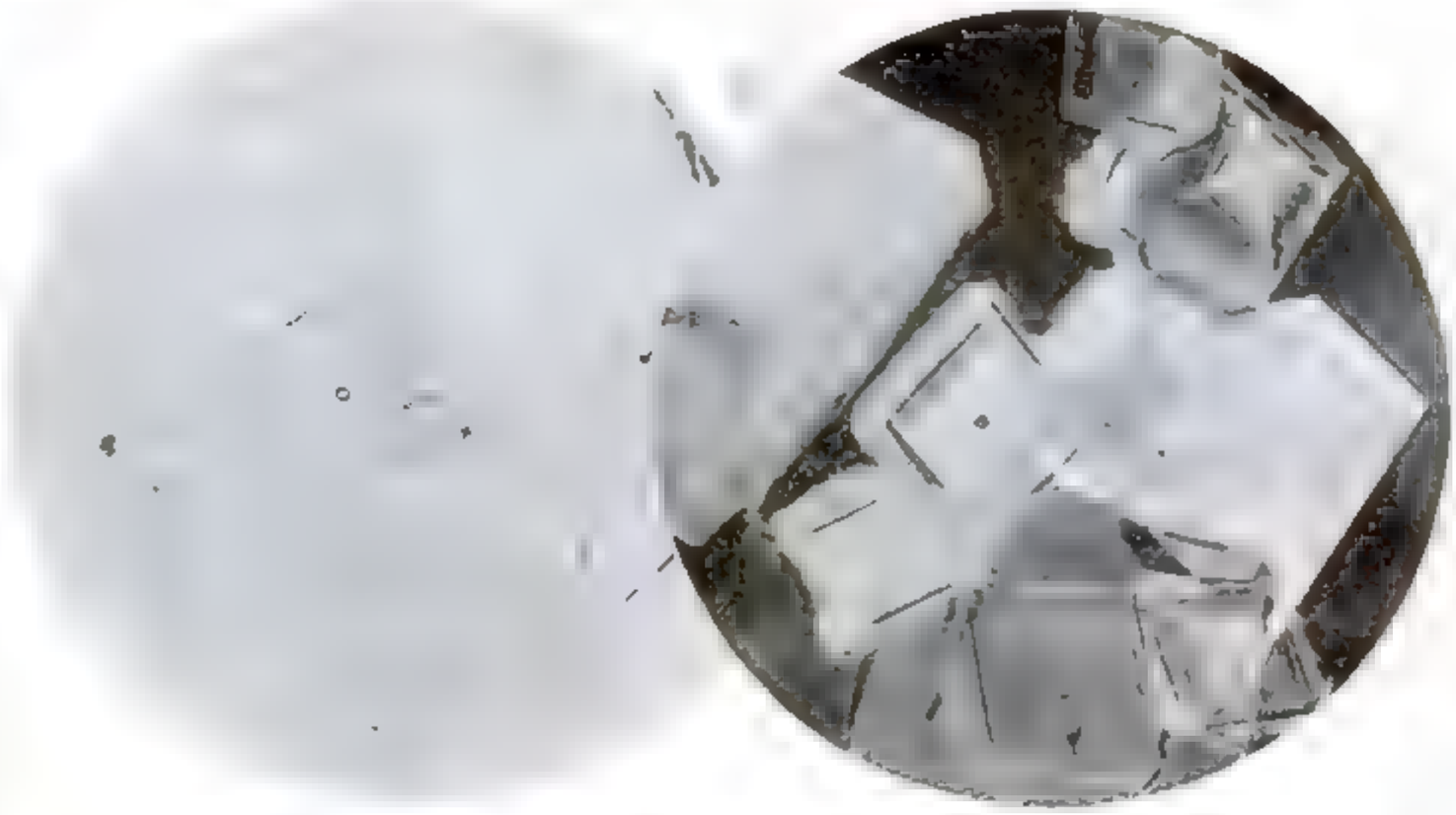
As you know, light is considered as being a series of waves traveling through the ether and vibrating at right angles to the direction of travel, each wave curving back and forth something like a snake traveling at full speed. Normally, these waves vibrate in every direction, resembling a tangled mass of squirming snakes all headed the same way.

Light vibrating in every direction behaves in certain well-known ways. But when only those vibrations traveling in one narrow plane are singled out and used to illuminate objects, remarkable things happen. Light vibrating in but one plane is said to be polarized, and the device used for sifting out such waves is called a polarizer.

If you want to try a simple experiment showing just how a polarizer works, run a length of rope through a picket fence and fasten one end to some stationary object; then grasp the other end in your hand and wave the rope so that it snakes up and down in graceful waves. As long as you move your hand in a direction parallel to the pickets, the rope will behave nicely; but try to make the waves run from one end to the other when you vibrate it crosswise to the pickets! The rope in this example corresponds to a light wave.

If there is another picket fence a short distance from the first, the rope could vibrate with ease through both fences when the pickets are parallel; but if the cracks in the second fence were at right angles to those in the other, the vibrations along the rope would stop on reaching it.

And so, in the polarizing microscope, there is a polarizer that screens out all

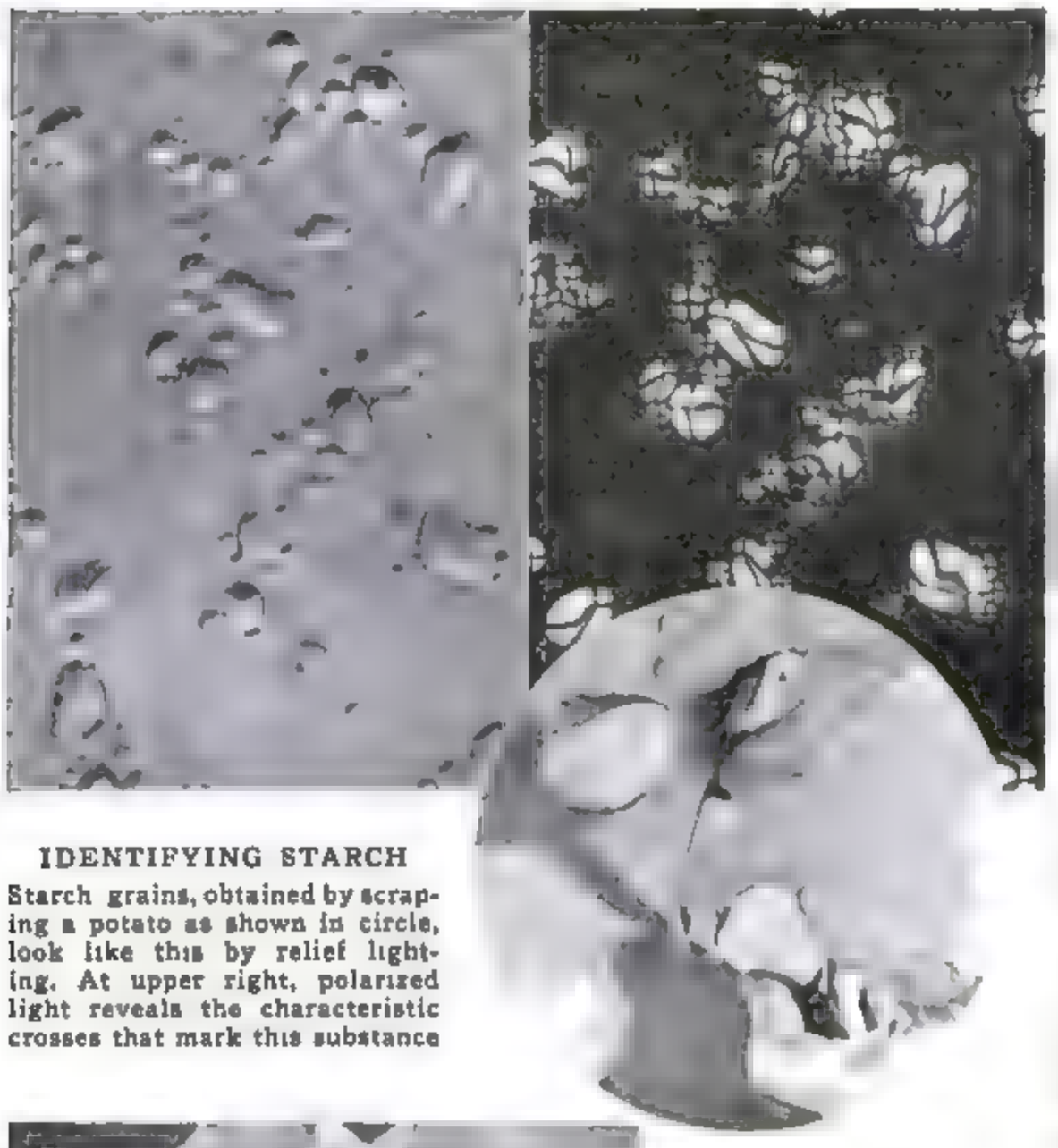


ORDINARY CRYSTALS ARE TRANSFORMED INTO SPARKLING JEWELS

The photomicrograph at the left shows how crystals of potassium chlorate appear when viewed by ordinary illumination. They are all of one color and only moderately distinct as to structure. At the right, note the magic transformation that is brought about by the polarizing disks

for POLARIZED LIGHT

Inexpensive Attachments Available to Amateurs Open the Door to a Wonderland of Beauty

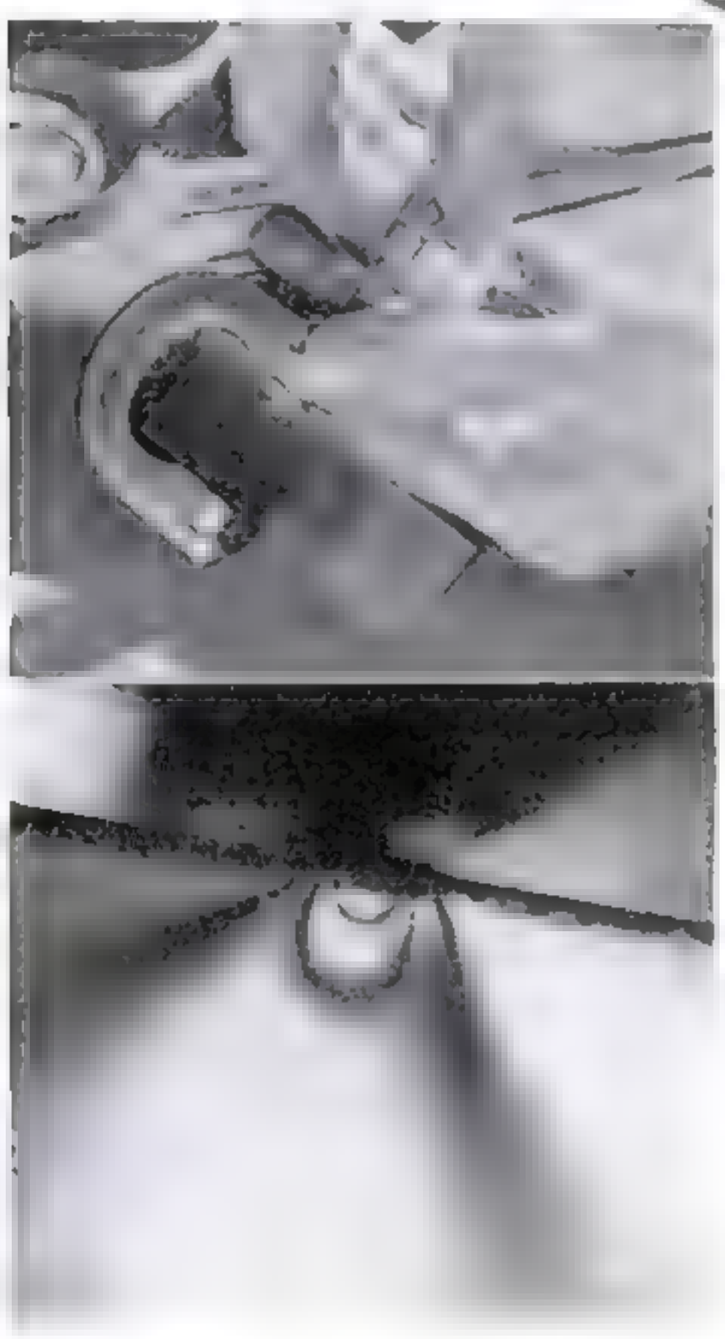


IDENTIFYING STARCH

Starch grains, obtained by scraping a potato as shown in circle, look like this by relief lighting. At upper right, polarized light reveals the characteristic crosses that mark this substance

WITH A DISSECTING LENS

Polarizing disks in use with an inexpensive dissecting microscope. One disk is held over the lens, and the other is mounted on the illuminator



LINES OF STRAIN IN GLASS.

Squeezing a microscope slide in a clamp, as illustrated in the upper picture, sets up lines of strain which show up clearly under polarized light. Note the odd pattern of concentric arcs

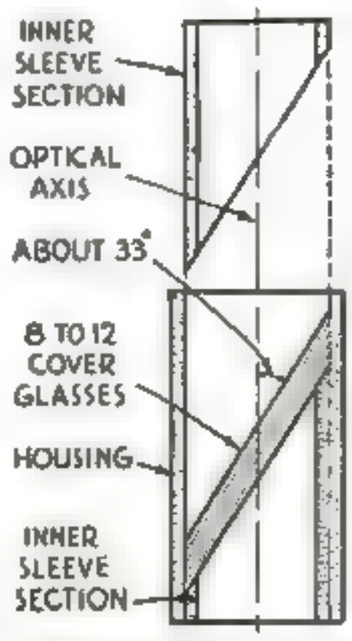
wave lengths save those vibrating in one plane, and then a second polarizer, usually called an analyzer, exactly like the first, which sometimes lets the polarized light pass through, and sometimes holds the waves back, depending on its position with respect to the first polarizer.

Thus you see that polarizing devices are used nearly always in pairs in connection with the microscope, and that they can be adjusted so that the light that the first one passes is stopped by the second. The first polarizer usually is placed beneath the microscope stage or somewhere else in the beam of light illuminating the object, and the second polarizer, or analyzer, is placed above, inside, or below the eyepiece. One or the other must be mounted so that it can be rotated.

The value of this set-up comes from the fact that some materials behave in such a way that a beam of polarized white light falling upon them is split up into two beams that vibrate in planes at right angles to each other, and travel through the material at different velocities. These two beams get out of step as they pass through the material, so that some wave lengths as they emerge are polarized in one direction, and others are polarized at right angles to that direction. Now, it is difference in wave lengths that determines color; and so, when the second polarizing unit enables your eye to see only the rays vibrating in one plane, the crystal, or whatever the object is, appears colored. These colors frequently are very vivid and beautiful.

As one of the polarizing units is turned, the colors change. A crystal or bit of crystal that appears in one color when the unit is in one position, will appear in the complementary color when the polarizer has been rotated ninety degrees. Thus, a blue crystal becomes yellow; a green crystal, magenta, and a red one, blue-green.

In the past, the most satisfactory way in which an ordinary microscope could be converted into a polarizing instrument was by the use of Nicol prisms. These prisms are cut from Iceland spar, a crystalline substance that is by nature double-refracting and therefore capable of splitting a light beam up into two polarized beams vibrating at right angles to each other. The crystals are cut and mounted so that one beam is lost, and only one passes through. The first prism (really a pair of prisms cemented together), called the polarizer, is placed usually below the stage, and the second one, the analyzer, is mounted above or below the eyepiece. The cost of the prisms put this method of getting polarized light out of the reach of most amateurs.

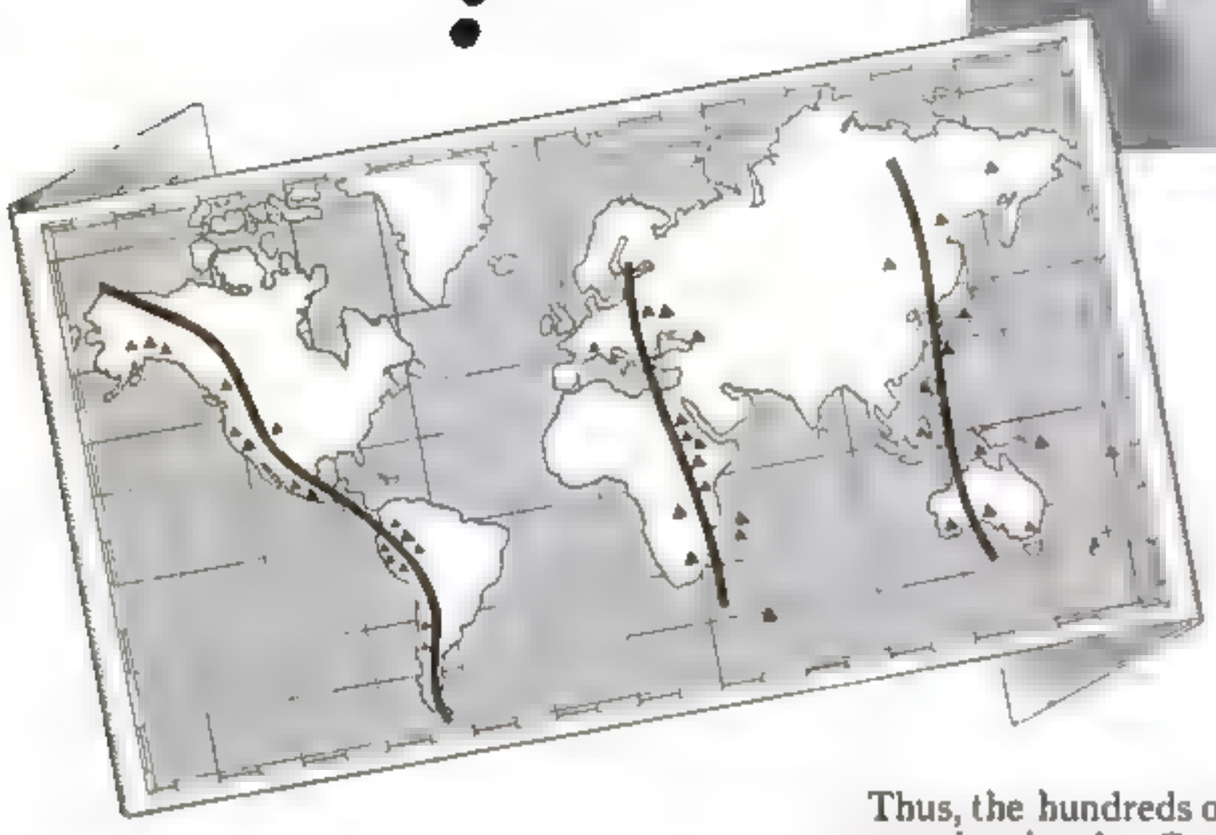


Details of a homemade polarizing attachment

Said to be superior in some ways to the Nicol prism is the new polarizing material in sheet form. You have heard a lot about it lately, and you undoubtedly will hear a great deal more in the future, for it is adaptable to a great many things besides microscopy—such as photography, and the elimination of automobile-headlight glare. This material is more like the picket fence of our example than any other common polarizing device, for it consists of parallel lines of very *(Continued on page 110)*

Is the Earth a Pyramid ?

When air is sucked out of a hollow rubber ball, the surface arranges itself into ridges and hollows corresponding, respectively, to the land masses and ocean deeps of the earth, as seen in the clay model



Lines drawn down from what would be the three upper "corners" of the earth reveal that most of its volcanoes are on the edges of the supposed pyramid

YOU wouldn't expect to find one person in a hundred who would deny that the world is round. Yet most astronomers agree that our planet is far from being a perfect sphere —and there even is a theory, accepted by some scientists, that it is a tetrahedron, or four-faced pyramid!

The queer-looking clay model illustrated on these pages, representing the earth as visioned by this theory, has little resemblance to the familiar "terrestrial globe" of the schoolroom. With a rubber ball and a length of tubing, you can demonstrate the principle which, in the opinion of many experts, has caused the world to assume this odd shape.

A glance at the pictures of the model reveals a significant fact: The "four great oceans" you learned about in geography occupy the four triangular faces of the inverted pyramid, while the four great continental masses are placed at the corners and along the edges, tapering toward the point representing the south pole.

When four meat skewers are thrust through the pyramid, each passing from a corner to the face opposite it, we see that each corner coincides with one of the world's great mountain systems, and that each region of great peaks is balanced, on the opposite side of the earth, by one of the great ocean hollows.

Thus, the hundreds of great snow-capped mountains in the Canadian Rockies are almost exactly opposite to the Indian Ocean; the Alps of Europe are directly opposite to the deeps of the Pacific; the great peaks of the Himalayas and China are straight through the earth from the Atlantic; and the deep, almost landless Arctic Ocean is opposed to the antarctic continent, with its large mountains, including Mt. Erebus and Mt. Terror.

When the theory of opposing mountains and ocean hollows was first proposed by the late William Lowthian Green, neither northern nor southern polar region had been thoroughly discovered and explored. But now the finding of a deep ocean covering the north pole, and a mountainous continent over the south pole, has given further support to his belief.

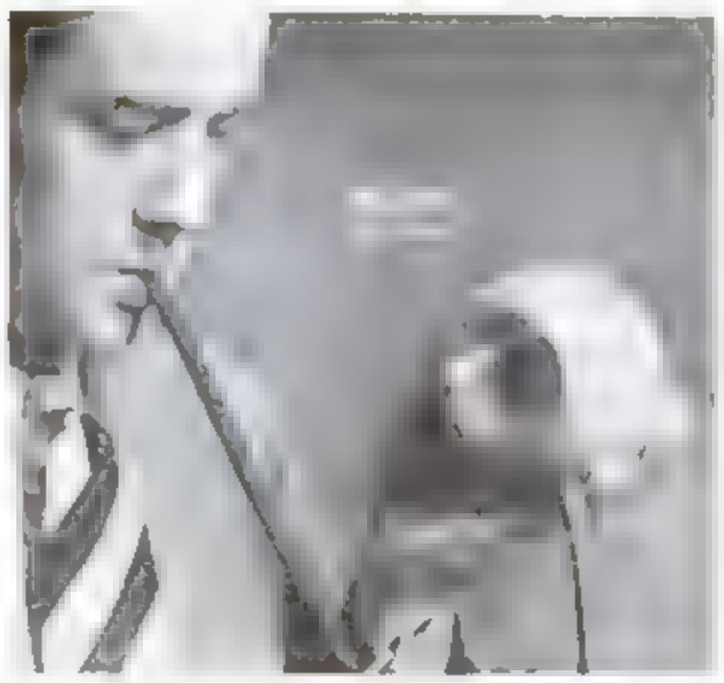
You may be wondering what forces could have worked to produce this remarkable balancing of four continental masses against four great oceans. The simple experiment to be described illustrates very clearly how the four-sided shape of the earth may have resulted from the process of its cooling and shrinking from the molten ball which it was in the very beginning.

In that primitive, semiliquid state, our planet was nearly spherical. However, as a solid crust developed and the interior continued to shrink, the crust became a little too large for the inside, and ridges and hollows began to be formed, just as they are in the skin of an apple which shrinks by drying out. In the case of the earth, the ridges became mountains, and the hollows became seas.

This did not occur in a haphazard manner, but in accordance with a well-established mechanical principle. If we suck the air out of a hollow rubber ball which has a fairly thick skin, thus shrinking or collapsing the ball gradually, we may expect to see this principle operate and produce a shape roughly like the four-sided pyramid which was formed from the crust of the shrinking earth-ball.

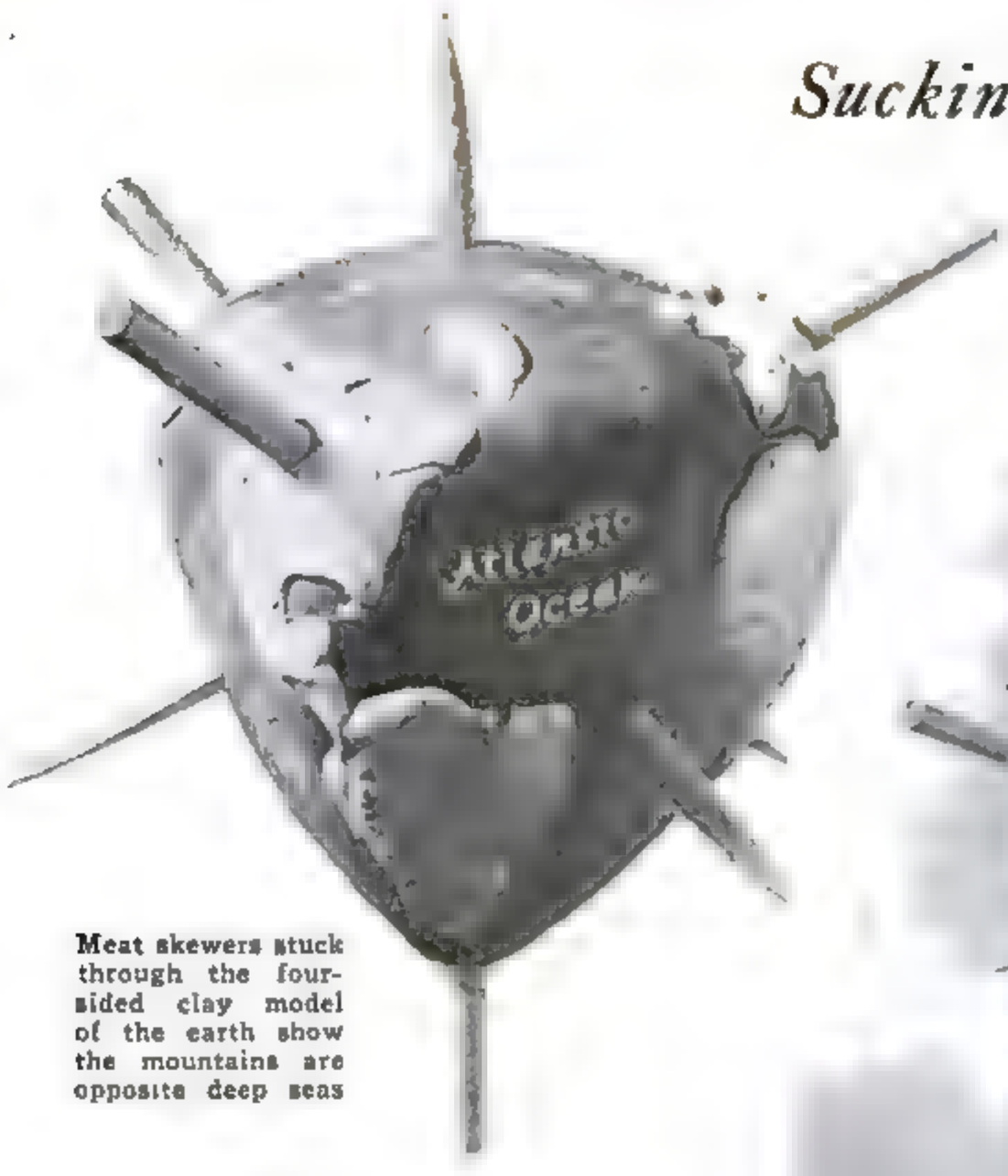
In a toy store I found a twenty-five-cent play ball which could be inflated with a tire pump by means of a brass nipple furnished with the ball. The only additional apparatus needed for the experiment was a soft rubber tube with which to suck the air *out*, and a wire pinchcock to prevent its return.

The spring pinchcock, which squeezes the rubber tube, is opened with the fingers while the mouth sucks air from the ball,

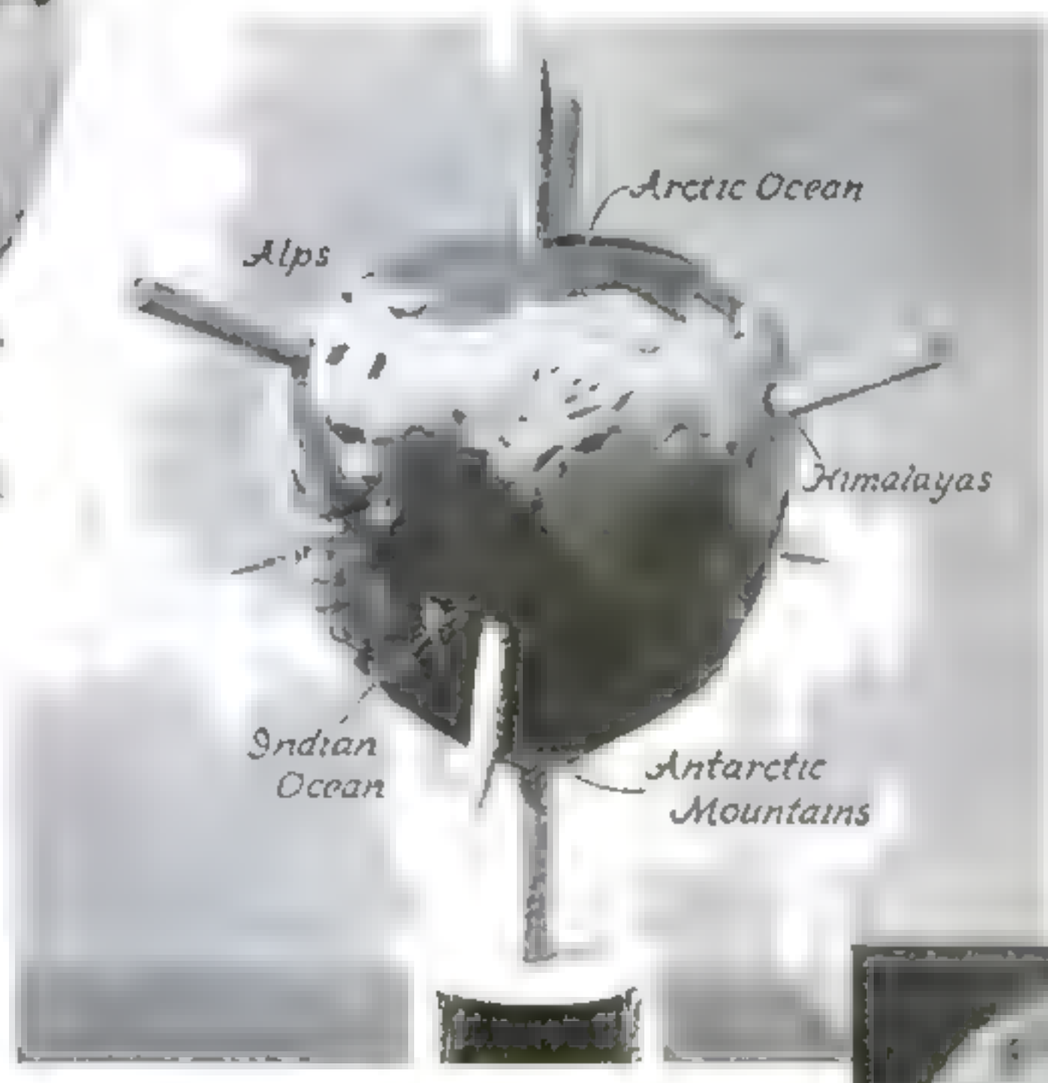


Through a rubber tube fitted with a pinchcock, the air is gradually withdrawn from the ball. Here the first hollow is just beginning to form

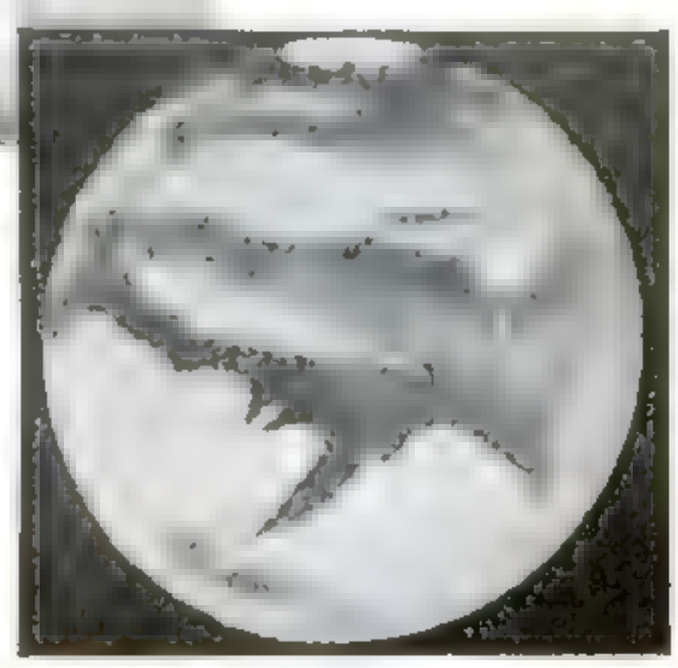
Sucking the Air out of a Ball Shows How Our Planet May Have Taken a Four-Sided Shape



Meat skewers stuck through the four-sided clay model of the earth show the mountains are opposite deep seas



The peaks of the Himalayas are straight through the earth from the deeps of the South Atlantic. Below is a telescopic photo of Mars, revealing the telltale triangular shape of its "continents," which may indicate that it is a pyramid



By GAYLORD JOHNSON

•

and is allowed to close while air is expelled from the lungs in preparation for another pull at the tube.

The group of successive photographs reveals how, as the operator sucks air gradually out of the hollow ball, the four great "ocean hollows" are drawn inward, one by one. Finally, when most of the air has been removed, the originally round ball is transformed into a roughly pyramidal shape—with four deep depressions separated by curving "mountain ranges" of rubber. Its striking resemblance to the clay model of the four-sided earth is shown in the photograph comparing them.

One caution needs to be observed in trying this experiment: You must prevent the first hollow formed from becoming so large that one half of the ball is simply collapsed into the other, forming a hollow rubber cup. This must be prevented with the fingers. When this is done, your continued deflation of the ball will invariably result in four hollows when the air is nearly all removed. I tried the experiment many times, and always with the same result as long as I prevented any one hollow from becoming too large.

In the case of the cooling and shrinking earth, the solid center supported the crust; in the case of our hollow ball, a complete inward collapse must be avoided.

What is the mechanical principle which thus produces a four-sided pyramid from a shrinking sphere? Why is this particular figure produced, and not a six-sided cube, or an eight or ten-sided shape?

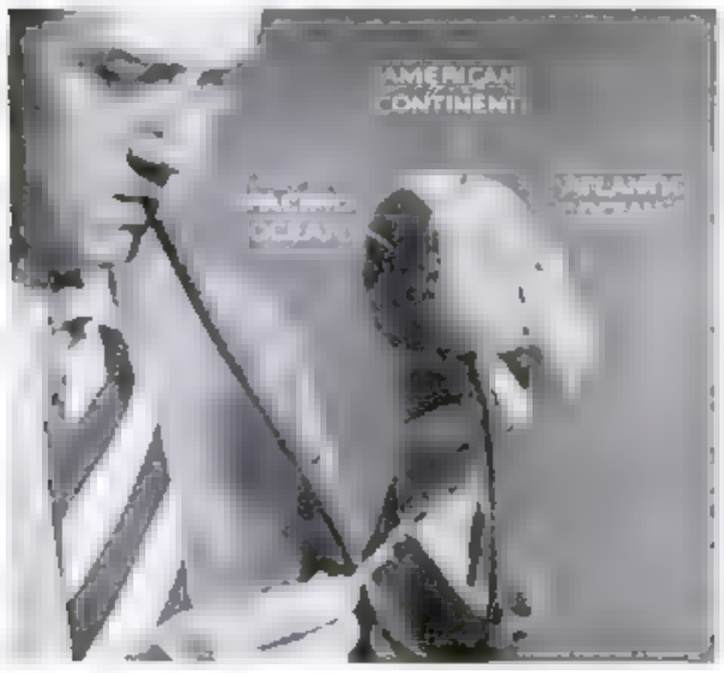
Here is the answer, as science gives it: a tetrahedron, or four-sided pyramid, is the shape which has the greatest surface area with the smallest volume inside it. Accordingly, the skin of a shrinking sphere—whether ball or earth—tends to get into the tetrahedral shape, because that is the shape that will dispose most easily of the excess surface area.

The pushing up of the three great north-and-south continental mountain ridges at the edges of the tetrahedral earth has another very interesting result, shown in the map diagram. Where the crust was buckled and folded into ranges, it naturally cracked in several places, allowing the molten interior to escape. This, according to our theory, is why we find most of the world's great volcanoes distributed along these main lines of mountains.

If the wedge-shaped continents of the earth are evidences that our planet is slightly pyramidal, what about the shapes of the other planets? May we not expect that the same shrinking principle may be at work upon them, changing their shapes toward tetrahedrons?

We know that Jupiter, Saturn, Uranus, and Neptune are probably still in a semi-liquid or plastic condition; their evolution has not yet formed a stable crust. Venus is always hidden by her blanket of clouds. Mercury has too few markings to give any idea of the distribution of its heights and hollows. Mars, our nearest neighbor, is the only one we can use for comparison.

The only hint is given by pictures made through telescopes—and it is a very interesting hint, for some of the shapes on Mars run to points toward one of its poles, just as the continents of the earth do! If these shapes on Mars really are continents, perhaps the same mechanical principle has also forced this planet toward the four-sided form which may be our own earth's true shape.



In performing this experiment, it is necessary to prevent the first hollow from becoming too large. This is done by guiding with the fingers

Finally, when most of the air has been removed, the ball is transformed into a roughly pyramidal shape, with four depressions divided by ridges

Home Chemistry WITH SIMPLE APPARATUS

FUNNELS MAKE "GAS PISTOL"

When this simple device is filled with gas, as at the left, and a flame is applied to the spout, a yellow flame is produced. Then, as air mixes with the gas, it pops loudly

By RAYMOND B. WAILES

SOME of the most interesting chemical experiments require only the simplest of apparatus and materials. Among such tests that you can add to your home-laboratory repertoire are making a "gas pistol" that produces harmless explosions; using a small electrical set-up to make metals react with a variety of vapors; and performing a "slow-motion" diffusion experiment in which you will learn how to identify different kinds of alcohol.

The gas pistol is made from a pair of ordinary kitchen funnels fastened together at the large ends. If you use tin funnels, the edges will be easy to join with solder. In case the funnels are of aluminum, or if you are inexperienced in soldering, a strip of adhesive tape will make a sufficiently tight joint. Remove the spout of one of the funnels, smoothing any sharp edges that are left.

Hold your gas pistol with the remaining spout up, and fill the interior with illuminating gas. The gas may be admitted through a rubber tube fitted with a pinch clamp, and you can then hold the tube against the funnel spout and control the gas supply with the same hand. In case your laboratory workbench is not piped for gas, it should not be difficult to find a place nearby where a connection can be made.

When all the air in the pistol has been displaced by gas, which will take about ten seconds, close the pinch clamp, and remove the supply tube. Immediately apply a lighted candle, kept ready for the purpose, to the spout. A yellow flame is produced as the candle ignites gas driven from the spout by air entering the pistol at the bottom. At first, the gas is unmixed with air, and will burn but not explode.

As you watch, however, the gas flame becomes smaller and paler. This is because air entering the pistol from below is now mixing with the gas. Before long, sufficient air will have entered to form an explosive mixture with the gas. When this happens, the flame suddenly travels down into the pistol and a mild explosion occurs. It is entirely harmless, because of the small quantity of gas used and the fact that the explosion products are not closely confined. Usually, the explosion occurs a few seconds after the gas is lighted, but you can delay it, if you wish, by pinching the spout of the funnel to reduce the size of the orifice.

Metals and nonmetals, such as iron and sulphur, react with each other to form a number of interesting compounds, but often it takes a high temperature to make the reaction occur. There is a simple way to provide this high temperature and to keep it under perfect control. All you need to do is make a coil of wire of the desired metal, heat it electrically, and surround it with whatever vapor you choose for the combination.

To make iron and sulphur interact, for instance, obtain some iron wire of about No. 30 gauge, B. & S. standard—which can be bought in spools at ten-cent stores—or unravel a single strand from a piece of picture wire. A length of about a foot is required for a single experiment. Make it into a coil and connect it to a household electric outlet in combination with an electric iron, a toaster, the heating element of a radiant heater, or any other appliance having a rating of about 600 to 660 watts. The connection should be made "in series," as shown in an accompanying diagram. A switch should be added to enable you to turn the current on or off at will.

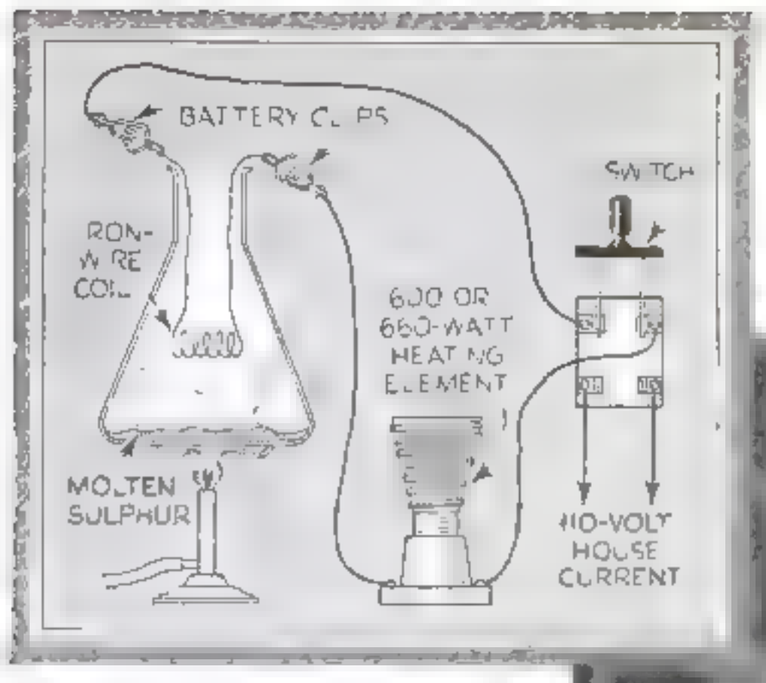
Test the coil you have made by closing the switch. If the wire is of the right size, it should glow red-hot when the current is turned on. Wire that is too thin will burn out, while wire that is too thick will not get hot at all. By experiment, you can determine the right size to use.

Suspend the electric coil in a flask containing flowers of sulphur, or common powdered sulphur, and heat the flask. When the molten sulphur has begun to boil, close the electric switch momentarily. There will be a gentle, harmless explosion as the heated wire ignites the mixture of sulphur vapor and air in the flask. The current should be cut off at once to keep the wire from burning out. After the explosion, the interior of the flask becomes clear and transparent as the vapor clears. If the

DEMONSTRATING OSMOSIS

Water is being drawn from the bottom of the tube for tests to prove that the layers of liquid have mixed

Here are some easy chemical ***experiments that can be performed without elaborate equipment,*** *yet are spectacular and filled* ***with interest***



HEAT CAUSES REACTION

A coil of iron wire, hung in sulphur vapor, is heated by the passing of an electric current. When hot, the iron reacts with the vapor to form iron sulphide

current is not allowed to flow too long at a time, the miniature explosion can be repeated again and again.

Finally, with the current kept on, the coil will remain red-hot and the chemical reaction between it and the sulphur vapor will take place. The surface of the wire first seems to boil as if it were molten. Suddenly, the interaction occurs, so rapidly and with so much generation of heat that the wire immediately burns out. A residue of ferrous sulphide, or iron sulphide, remains.

Try repeating this experiment, using sulphur as before but substituting wires of other metals for the iron wire. You will find it interesting to compare the compounds formed, which are sulphides of the respective metals. Avoid using magnesium metal for this purpose, however; it reacts so vigorously with sulphur that, under certain conditions, the experiment might be hazardous.

Many other vapors besides sulphur can be induced to combine with metals at high temperatures, as you can show with the apparatus just described. Place potassium chlorate, mixed with a little manganese dioxide, in the flask instead of sulphur, and you will obtain oxygen vapor when the vessel is heated. In an atmosphere of this gas, hot iron wire burns with dazzling brilliancy.

Other suitable materials will enable you to try the effect of chlorine, iodine, and carbon dioxide gases upon electrically heated coils of metal wire. Iodine vapor may be obtained by heating the pure, solid crystals. Do not use tincture of iodine, the common household preparation, in this experiment; the alcohol it contains would form a vapor that might cause an undesirably powerful explosion when ignited by the hot wire.

Magnesium metal can safely be used in an electrically heated coil surrounded by an atmosphere of carbon dioxide. If this interesting experiment is properly carried out, you should observe white magnesium oxide, or magnesia, formed from the metal, and free carbon liberated in flaky form.

Another experiment with magnesium, dispensing with the use of the electrical hook-up, will show how the silvery metal reacts with steam. Boil water in a flask and lead the vapor through a glass tube containing a piece of magnesium ribbon, made bright with emery cloth. After the steam has passed over the metal for a few minutes, you will notice a white crust of magnesium oxide deposited on the ribbon and on the walls of the tube. The metal decomposes the water vapor and combines with its oxygen. Hydrogen gas is released, although in such minute quantities that it would ordinarily escape detection.

Demonstrations of the phenomena of diffusion and osmosis, which have to do with the intermingling of substances because of the motions of their molecules, might be called "lazy man's experiments." After liquids used in such tests have been placed in layers in a vessel, there is nothing more to do but wait until the action goes to completion, which may take weeks

To perform one of these slow-motion experiments, select a piece of glass tubing of half-inch or one-inch diameter, cut it to a six-inch length, and mount it upright. Assemble a medicine-dropper tip, a rubber tube with a pinch clamp, and a short length of glass tubing, and pass the latter through a one-hole stopper inserted in the bottom of the vertical tubing. Now pour water into the main tube until the liquid stands about an inch above its bottom. Next, add a half-inch layer of castor oil or of turpentine, above the water; and, finally, a top layer of alcohol that has already been diluted with an equal volume of water. The apparatus may then be put away to stand for several days

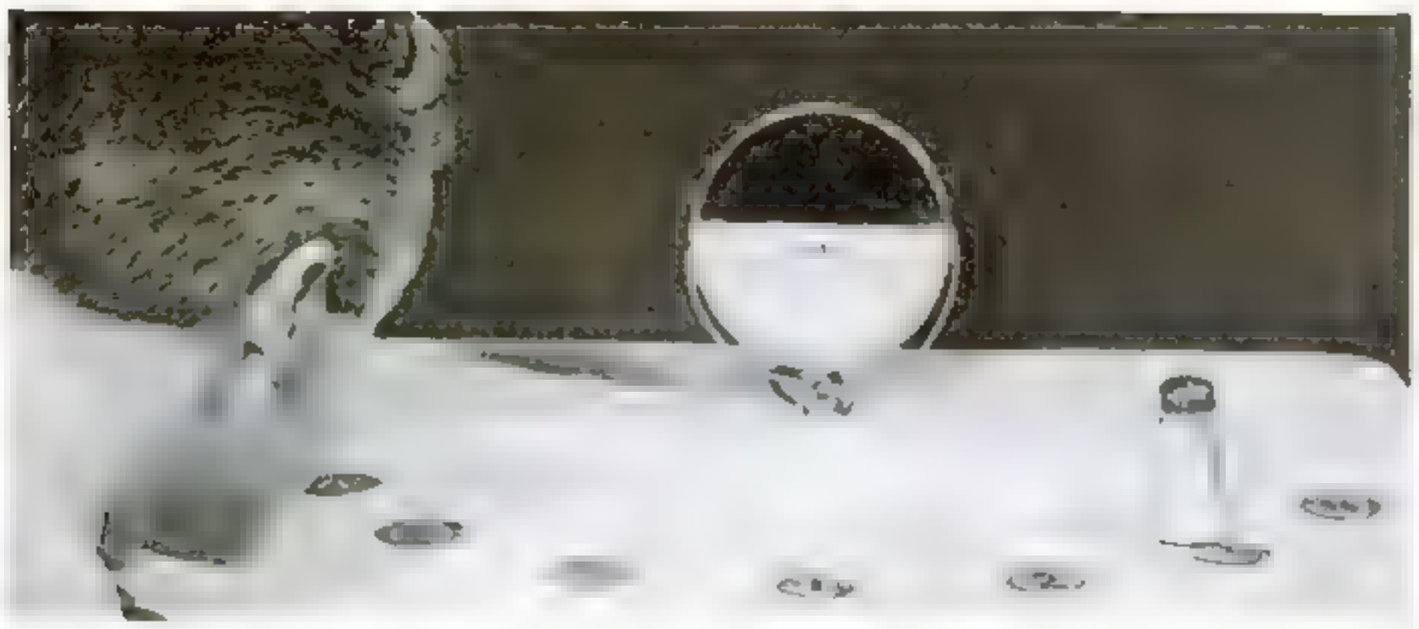
The difference in specific gravities of the three liquid layers tends to keep them apart, but it is insufficient to keep molecular action from mixing them. Within a week, at most, an appreciable amount of alcohol will have diffused downward through the central oil layer and will have reached the water at the bottom. Molecules of water also tend to migrate upward toward the alcohol, but the extreme insolubility of water in the dividing layer prevents this action from going far. The oil or turpentine might be said to act as a semipermeable "liquid membrane."

That the alcohol does reach the water after a few days can be demonstrated by opening the pinch *(Continued on page 130)*

Lifter for Evaporating Dish

A PIE-PLATE HOLDER makes a useful laboratory accessory for lifting large, flat evaporating dishes with their hot contents from the flame of your Bunsen burner. Ordinarily used for taking a hot pie from an oven, an implement of this kind can be obtained for ten or fifteen cents at shops dealing in household novelties, or at the kitchen counters of ten-cent stores. It comes in handy when good-sized batches of chemicals are evaporated or digested, as shown in the photograph.

NOVEL TESTS OF Scientific Laws

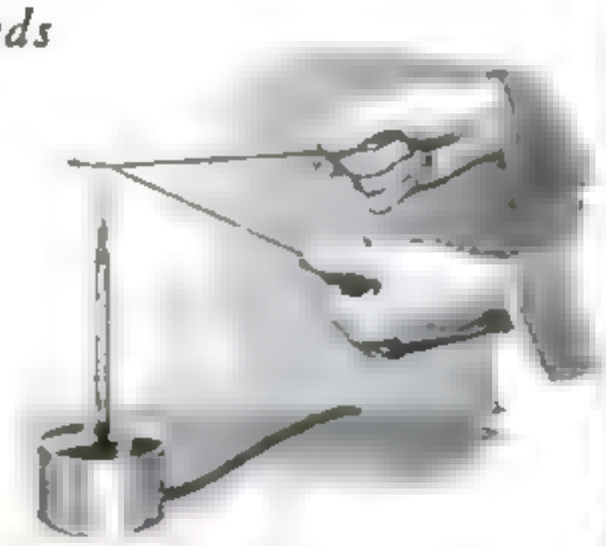


Experiment Demonstrates Angles of Reflection

ARRANGE seven cardboard disks in a semicircle in front of a mirror and number those from the center to one side. Place an object on one of the numbered disks and sight over the others until you can see the reflection of the object in the mirror. Mark this disk with the same number as the disk on which the object rested. Repeat for the other disks. The order of the numbers shows that the angle from which the object is seen is equal to its own angle from the mirror.

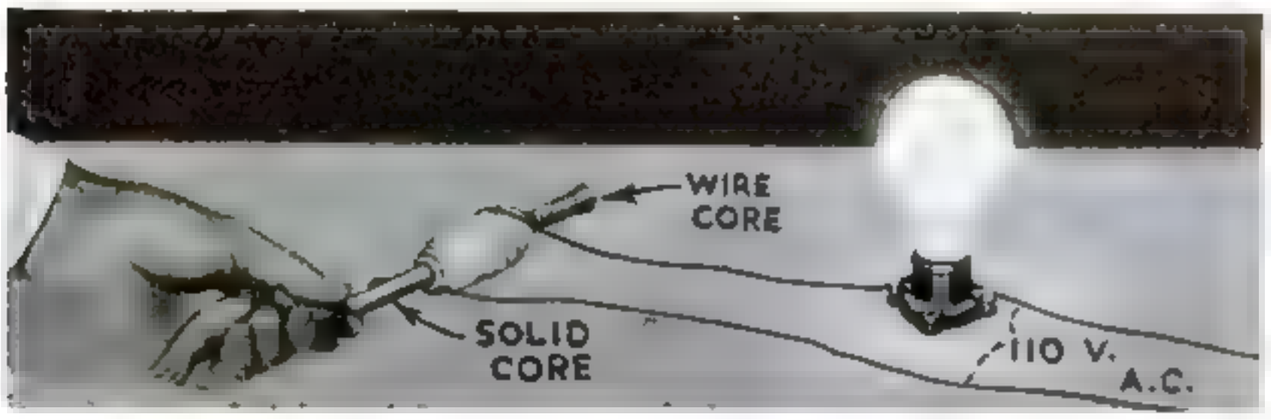
Heat Travels at Different Speeds

IF YOU try this experiment, you won't have to take it on faith that copper conducts heat better than iron; you will *know* it. Twist together the ends of an iron wire and a copper wire of the same diameter, and hold the joined ends in a flame as pictured at the right. In a short time, the copper wire will be too hot to hold, while the iron wire will still be cold. Copper conducts heat about six times as well as iron. It is an interesting fact that metals which are good conductors of electricity are also good conductors of heat, as tests by this method will prove to you.



Shows How Liquids Differ in Weight

DIFFERENCE in weight between two liquids can be shown with a simple apparatus in which a Y tube connects a single rubber tube to two glass tubes. The two liquids to be compared are drawn up, one into each tube, by sucking on the rubber tube as shown above. The lighter liquid will rise higher than the heavier one. To find the specific gravity of a liquid, compare it with water in this way and divide the height of its column into that of the column of water in the other tube.



Why Cores of Transformer Coils Are Laminated

THE cores on which wire is wound in alternating-current transformers are almost never made of solid metal. To see why, connect a small coil in series with a lamp as shown above. Slip a laminated, or iron-wire core into one end of the coil and a solid iron core into the other. After the current has been on for a short time, the solid core will be too hot to hold. The heat is caused by "eddy currents" set up in the solid core by changing magnetism as the current alternates. In a laminated core, these currents are broken up.

Dew Point Determines When It Rains

PUT a thermometer into a glass half filled with water at room temperature, and slowly add cracked ice to the water until a frost or dew begins to form on the outside of the glass. Note the temperature at which this occurs. Now, slowly add warm water to the water in the glass, and note the temperature at which the dew just disappears. The average of the two temperatures will be the dew point of the air in the room. This point varies constantly with the temperature and relative humidity of the air. When clouds reach the dew point of the atmosphere, their vapor condenses into rain.

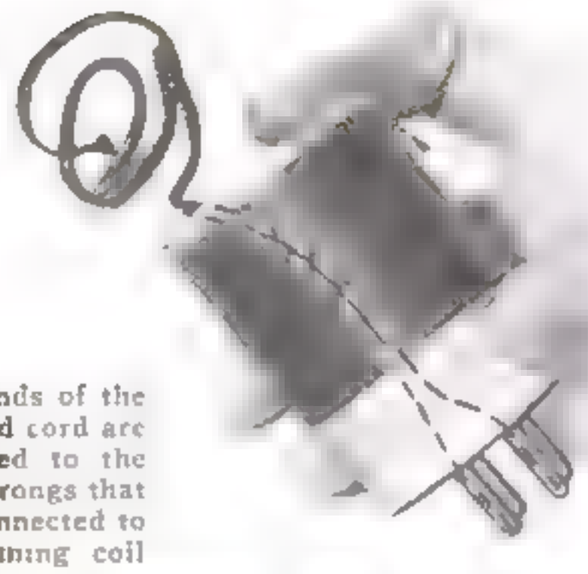
Sound Sets Up Air Vibrations in Tube and Blows Out a Candle

YOU can make a noise blow out a candle, in this simple experiment. Stretch a piece of thin rubber over one end of a long mailing tube; over the other end fit a paper funnel tapering at the small end to a hole about a quarter of an inch in diameter. Place this apparatus so that the hole of the funnel is aimed near the wick of a lighted candle. By tapping lightly on the rubber membrane, or clapping two books together near it, you can cause the flame to be blown out.

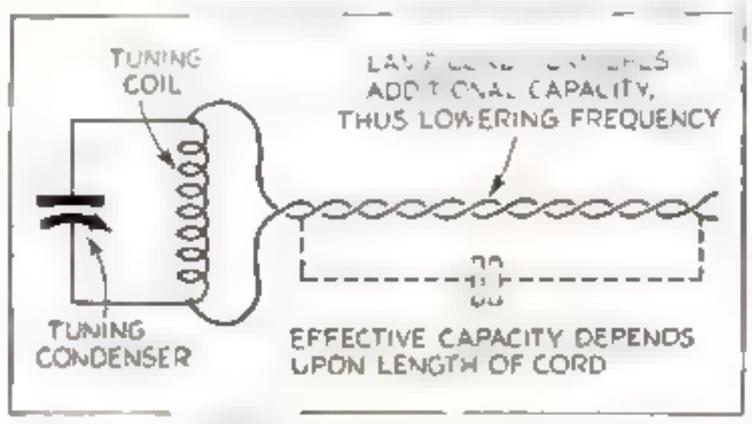
Six New Ideas
FOR RADIO ENTHUSIASTS

Cord Boosts Capacity Of Plug-In Coil

HOMEMADE plug-in coils that prove to have too few turns to cover the low-frequency end of a certain band, generally can be made to serve by means of the kink illustrated at the right. Simply bare the ends of a six-inch piece of small-diameter twisted lamp cord and solder the wires to the base prongs connected to the tuning, or grid, coil. The twisted wires, serving as a miniature condenser, add capacity to the circuit and lower the tuning range. By test and trial, the wires can be reduced in length until just the right amount of capacity is added.—L.B.R.



The ends of the twisted cord are soldered to the base prongs that are connected to the tuning coil

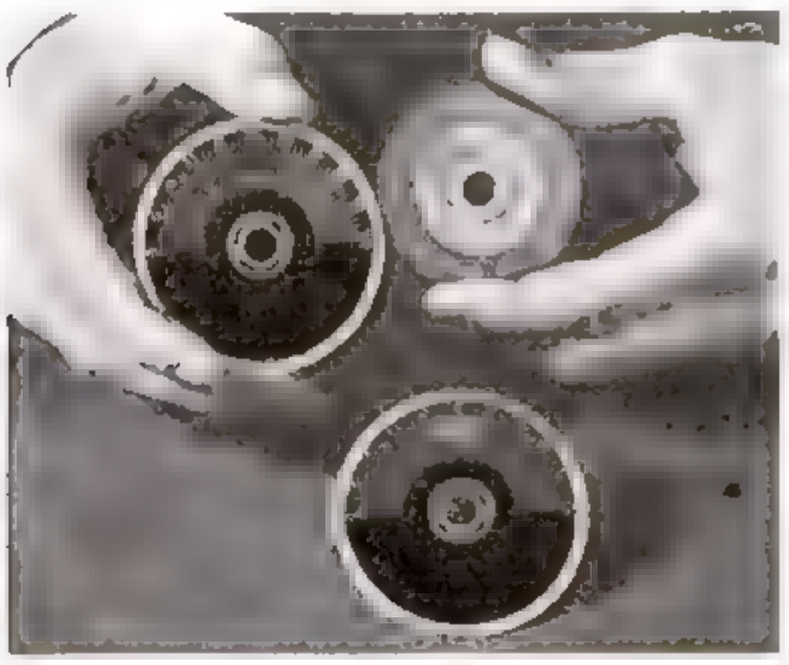


How the wires serve as a miniature condenser

Antenna Switch Speeds Up Tests

IF YOU do a great deal of experimenting and must change a single doublet antenna from one receiver to another in tests, you will find a new compact antenna switch a timesaver. Two terminals on the top of the switch box take the two antenna lead-in wires; phone-tip connections are provided for six receivers. Turning the switch transfers the antenna to the desired set.

Adaptable Dial Gives Labeled Controls



Calibrated outer shell fits over disk with labels

WITH an inexpensive dial now on the market it is a simple matter to provide your receivers and transmitters with labeled controls. Made of metal, the dial consists of two parts—a calibrated outer shell and an internal disk containing the attractively printed labels. To adjust the dial for a specific use, the disk is simply turned until the desired label appears in a window in the outer shell. If, for instance, the dial is to serve the amplifier, the disk is rotated until the label "amplifier" appears. Mounting the dial automatically fastens the label disk in place. Eight different labels are provided on the disk, as shown at the left.

Tool Starts Tiny Screws In Corners

Spring fingers grip slots to hold screws

PLACING small screws in tight corners becomes less of a problem when a screw starter of the type shown at the left is used. It consists simply of an insulated shaft fitted at each end with flexible spring-steel fingers. Compressed and pushed into the screw-head slot, the fingers spring apart and grip the screw firmly. The tool is particularly handy when it is necessary to place tiny shaft screws deep in a crowded cabinet.

Riveter and Eyelet-Bushing Punch Combined

RADIO builders who construct their own metal chassis and cabinets will find a recently marketed combination punch a handy addition to their workshop equipment. Used with a hammer, as shown at the right, the tool makes it an easy matter to supply protective eyelet bushings for holes drilled in a metal chassis to take lead wires. As a riveter, it simplifies the problem of fastening the corner joints in metal cabinets. The base of the punch can be used on the bench top, or can be clamped rigidly in a vise if the character of the work makes this desirable.

Combination punch in use for making eyelet bushings. Inset shows how it clinches rivets for corner joints

Where To Look for Trouble In Regenerative Receivers

WHEN a small homemade regenerative receiver that has been wired correctly fails to operate, the trouble generally can be located by three simple tests. First of all, the wiring to the grid of the tube should be checked carefully. All long grid leads should be shortened as much as possible. Second, inspect the prong connections to the plug-in coils. Try reversing the connections to the tickler (small) winding; this will take care of reversed tickler leads or a reversed winding. Lastly, check the variable-condenser wiring. Trace the terminal connections on the unit, which may be completely shorted out of the circuit.

YOU CAN IMPROVE YOUR RECEIVER WITH THIS Six-

The novel wave trap in use. It is housed in a small cabinet chosen to match the receiver

TUNING AID FOR RECEIVERS

Connected between the antenna and receiver, as shown in the diagram, this unit makes it easy to separate crowded stations, eliminate code interference, and strengthen signals

IF YOU have trouble tuning your new receiver, or find it hard to bring in distance, the all-purpose wave trap and antenna coupler shown will solve your difficulties. Connected between your antenna and receiver, it will make it easy to separate crowded stations, eliminate unwanted code interference, or increase the strength of weak signals from distant transmitters.

No matter how efficient a receiver may be, or how much it costs, it can be no better than its antenna system. Yet many radio fans have built special antennas to exact specifications only to find that the results did not warrant the additional work and expense involved. Others have constructed aerials similar in every respect to those used by friends who listen to the world on one- or two-tube sets, and yet on their own multitube superheterodynes the results have been far from satisfying.

The answer lies in the fact that an antenna system is something more than a wire strung high above the earth. Risking life and limb in erecting a sky wire twenty or thirty feet above the roof top is only half the problem. The signals that are picked up by the antenna must be efficiently transferred to the receiver, and herein lies the biggest obstacle in the entire system.

Although this difficulty can be overcome through the use of special antenna couplers, most of these units are designed to work most efficiently with one particular type of receiver. This is caused by the fact that, for best results, the coupling unit must be constructed to match the primary coil of the receiver.

Through the use of the all-purpose, adjustable coupling unit illustrated, however, these shortcomings are eliminated. With a flick of the wrist, the hook-up can be transformed into any one of six separate coupling circuits. The six arrangements, shown in the table of diagrams, provide the following coupling hook-ups:

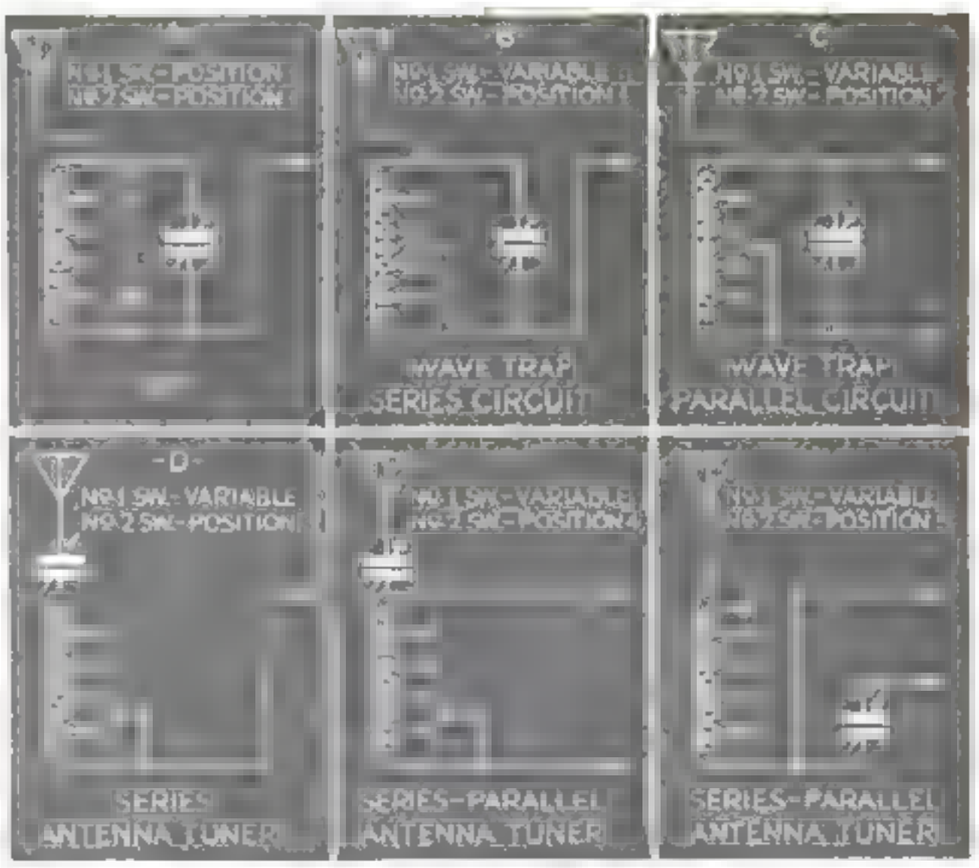
The off position *(A)* is obtained by short-circuiting the coupler unit with switch No. 1. This cuts the wave trap completely out of the antenna circuit and allows the receiver to operate independently.

A series wave-trap *rejector* circuit can be obtained by using the switching combination shown at *B*. Rejecting the signal to which the unit is tuned and allowing all other signals to pass on to the receiver, this arrangement is particularly valuable as a means for eliminating the interfering signals from a strong station, or the bothersome code signals that sometimes are heard on poorly designed superheterodyne receivers. In the latter case, the wave-trap tuner should be adjusted to the intermediate frequency of the receiver.

The hook-up shown at *C* is a parallel wave-trap circuit and is known as an *acceptor* circuit. It prevents signals both above and below the frequency to which it is tuned from being received. When using this circuit to eliminate interference,

SIX CIRCUITS COMBINED

The compact outfit and its two tuning coils. At right, drawings show the six different arrangements that give a choice of six coupling hook-ups



in-One Wave Trap

By CARL B. JORDAN

employ as much capacity as possible.

To provide a means for matching the antenna to the receiver and increase the volume as well as the selectivity, three antenna-tuning circuits *(D, E,* and *F)* are incorporated. Since much depends on the coupling in the receiver and the length of the antenna, it is impossible to predict which of these circuits will function best with a specific receiver. However, a few trials will quickly show the best switching arrangement.

At first glance, the schematic diagram may appear complicated, but it is in reality extremely simple. Anyone who has constructed a simple one-tube set should have little difficulty completing the wiring in an hour. Because of the general layout of the parts, it is advisable to wire the switch terminal connections first and then connect the leads to the variable condenser and coil socket.

As shown in the photographs, all parts are mounted on a simple rectangular baseboard of wood. This eliminates any necessity for troublesome metal work and, as a matter of fact, is better for this particular purpose since it prevents unnecessary losses.

To provide good band coverage and prevent loss of power on the high frequencies, two tuning coils of the plug-in type are used. These coils, designed to fit a standard six-prong socket, should be wound to cover the approximate frequency range from twenty megacycles to 465 kilocycles.

The large, low-frequency coil (L_1), covering from approximately forty meters up to and including the broadcast band, consists of 150 turns of No. 28 enameled wire close-wound and tapped at every thirtieth turn. The high-frequency coil (L_2) is made up of thirty turns of No. 20 double-cotton-covered wire tapped at every sixth turn and space-wound to approximately two inches.

In winding the coils, there are just two precautions: Use low-loss coil forms, and make sure that low-resistance connections are obtained when the tap leads are soldered to the coil windings and base prongs.

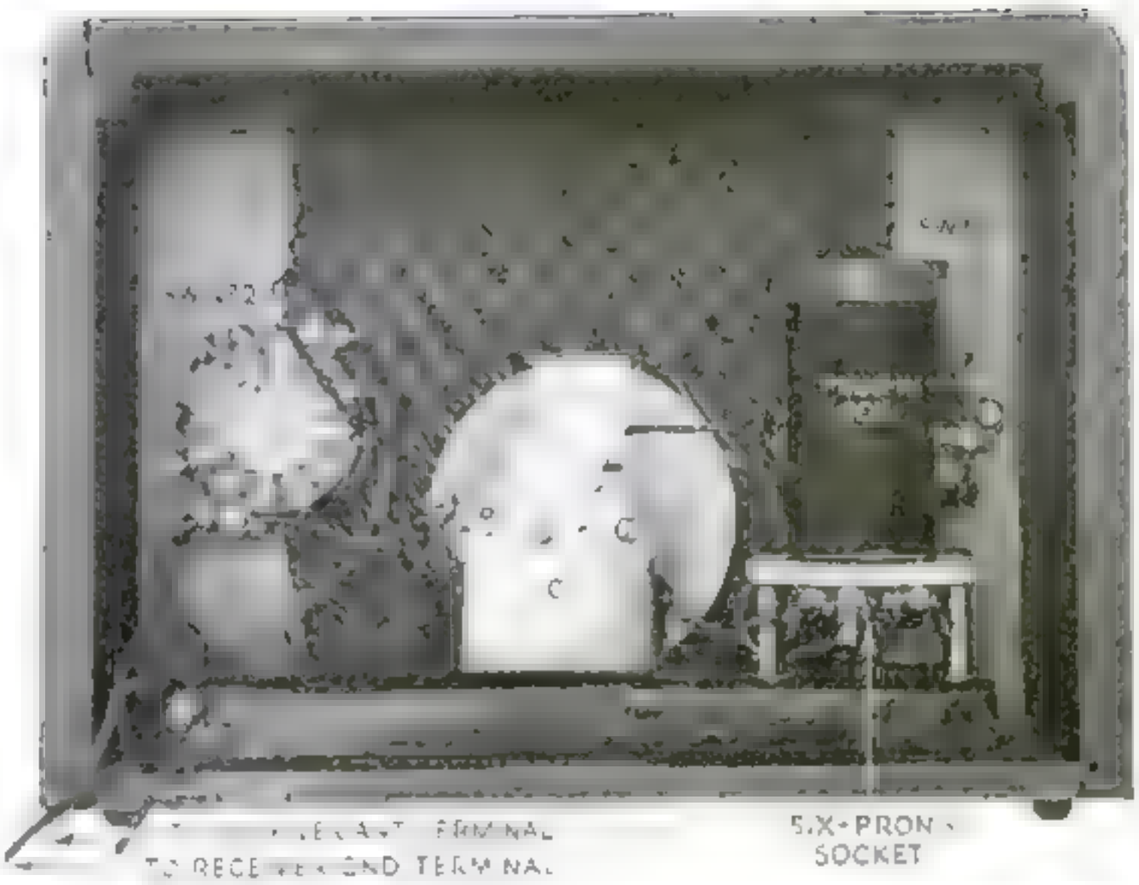
Although any type of multiple switch could be used, the units shown were selected because of their compactness and ease of operation. Switch No. 2 is a two-gang unit having four separate circuits, each circuit consisting of five contacts. Switch No. 1 is a single unit.

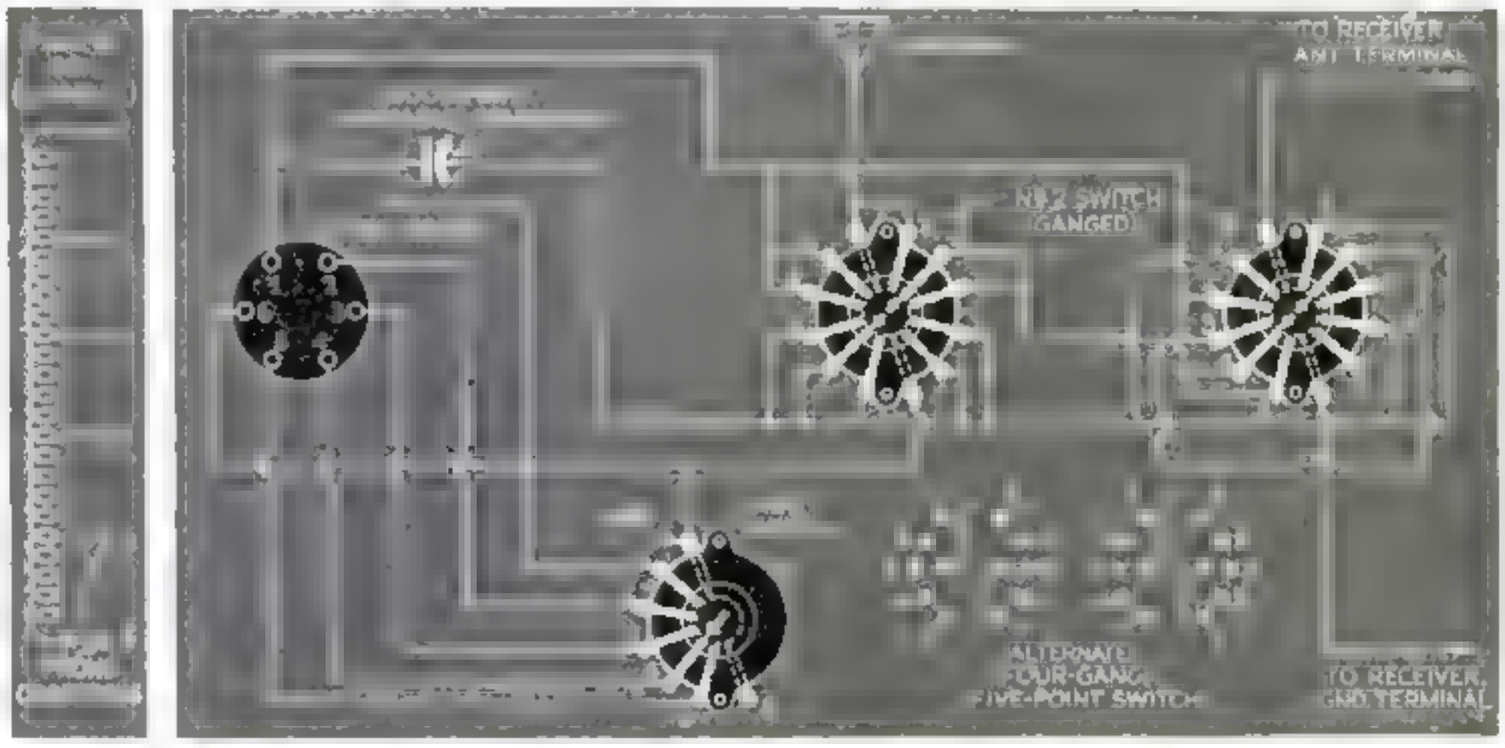
For a cabinet, an ordinary unit of the type used for small commercial receivers will fill the bill nicely. They are inexpensive and are made in a variety of finishes and designs.

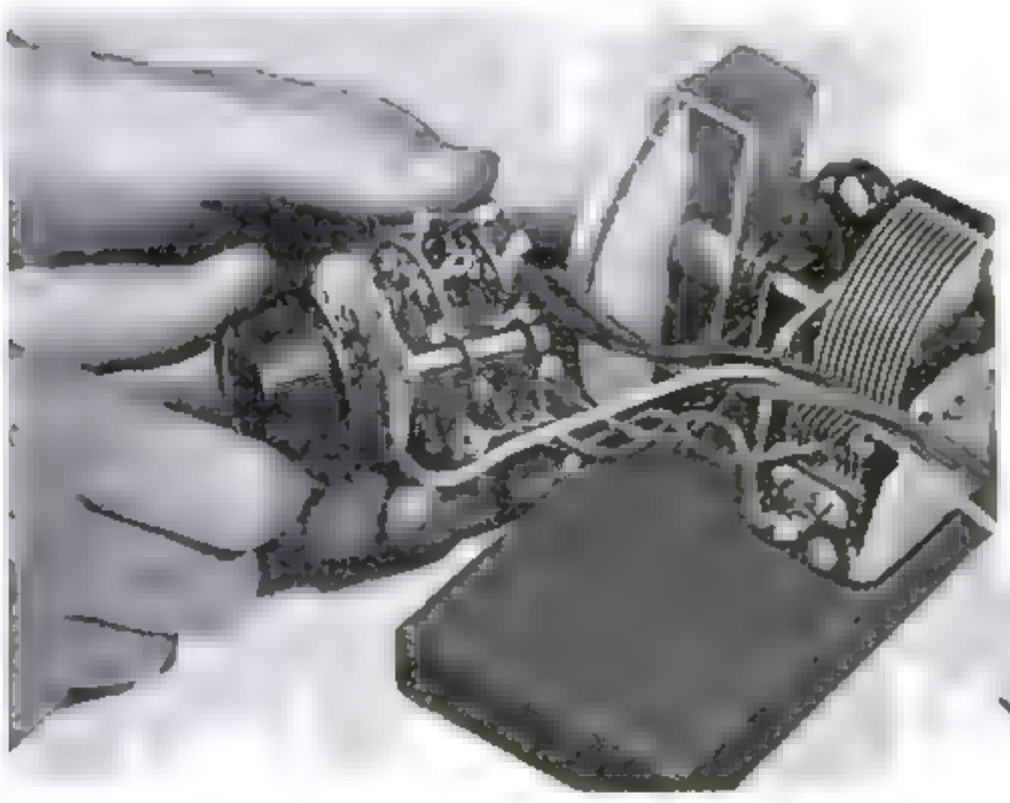
When the outfit is completed, connect it to your receiver and antenna by means of the three terminal wires as shown in the diagram. Then try the various switching arrangements, varying the capacity of the variable condenser to obtain the desired effect. When used as a wave trap, the condenser should be adjusted to eliminate the unwanted stations and bring out the desired signals. When used as an antenna coupler, the condenser should be regulated to give maximum volume and selectivity. Tune the condenser slowly; its adjustments may prove very critical.

HOW THE PARTS ARE ASSEMBLED

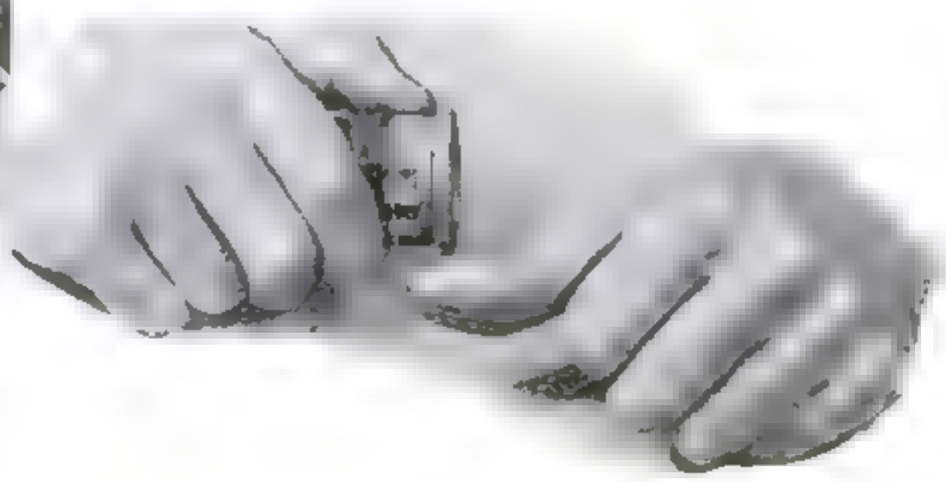
Back view of the cabinet. The parts are mounted on a wooden baseboard that eliminates troublesome metal work. The wiring of the parts is particularly simple, and can be completed in an hour







This compact two-gang switch has four separate circuits, each consisting of five contacts. It is shown here with the condenser



WINDING THE TWO TUNING COILS

The coils are wound on low-loss forms designed to fit a standard six-prong socket. It is important to have low-resistance connections for the tap leads

"There's my idea of a real outfit," Gus said, pulling open the door of a handsome trailer

Gus GIVES SOME Tips on Trailers

"THAT'S one fad that won't last long!" Nate Pendleton remarked derisively, as his eyes followed a trim, streamline motor trailer skimming smoothly down the road behind a smart new sedan.

Gus Wilson, half owner of the Model Garage, hung up the gas hose and replaced the filler cap on Pendleton's car. He smiled slowly. "Maybe so, Nate, maybe so," he observed, watching the trailer outfit disappear around a bend in the road. "But you've got to remember that it's a fad that has been popular, in one form or another, for a long time now. If it weren't for the fact that lots of our ancestors had a mighty strong urge to go places and do things, we wouldn't be here today. Touring in an automobile is just a modern form of that instinct, I guess."

"But why bother with towing an elaborate outfit in a trailer," Pendleton objected, "when you can stop at a good hotel? Or, if there isn't a hotel, there are sure to be tourist camps with cabins, or places with 'tourists accommodated' signs in the front yard."

"That's all a question of what you're trying to do and how much money you can afford to spend," said Gus. "If you're only interested in getting from one place to another a long distance away in the shortest possible time, then the hotel or tourist camp is the answer. But if you really want to take your time and see a lot of the country, and perhaps stay in different places weeks or even months at a time, then the motor-trailer outfit will give you the most comfort and convenience at a lot less expense than you can make the same tour on any other basis."

"I hadn't thought of it that way, Gus," Pendleton admitted. "I can see that there's an advantage in knowing just what kind of accommodations you're going to have, and being able to stop wherever you want to is a help. Some of the tourist camps and hotels aren't as conveniently located as they might be, and some I've stopped at were punk. If I hadn't thought this motor camping business was just a passing fad, I'd have taken it up before this."

"If you're really interested, come back in the shop a minute," Gus suggested.

Pendleton followed him into the Model Garage. Far over in one corner, Gus stopped. "There's my idea of a real outfit," he said, pulling open the door of a handsome motor trailer and stepping aside for Pendleton to enter. "Soon as the work slacks up a bit, I'm going to put in a month in Florida with a friend of mine, while Joe Clark, my partner, takes care of things. Then, next winter, Joe's going to take his wife and make the same trip. During the summer, we can take turns using it for shorter tours."

"Swell-looking job," Pendleton commented, as Gus showed him the neat arrangement of the "kitchen," the folding bunks, and the ingenious way in which every square inch of space was used to best advantage. "Where did you buy it, and how much did it cost?" he asked, with interest.

"Joe and I built it—Joe's pretty slick as a carpenter," Gus replied. "But you can buy one like it for anywhere from $600 to $2,000, depending on how elaborate the fittings are."

"Seems to me," Pendleton observed, "if you're going to build a house on wheels—which is what this outfit really is—you'd do better to buy a truck chassis and build the house body on it. Judging from the size of some of the truck bodies you pass on the road, you ought to have a lot more room that way."

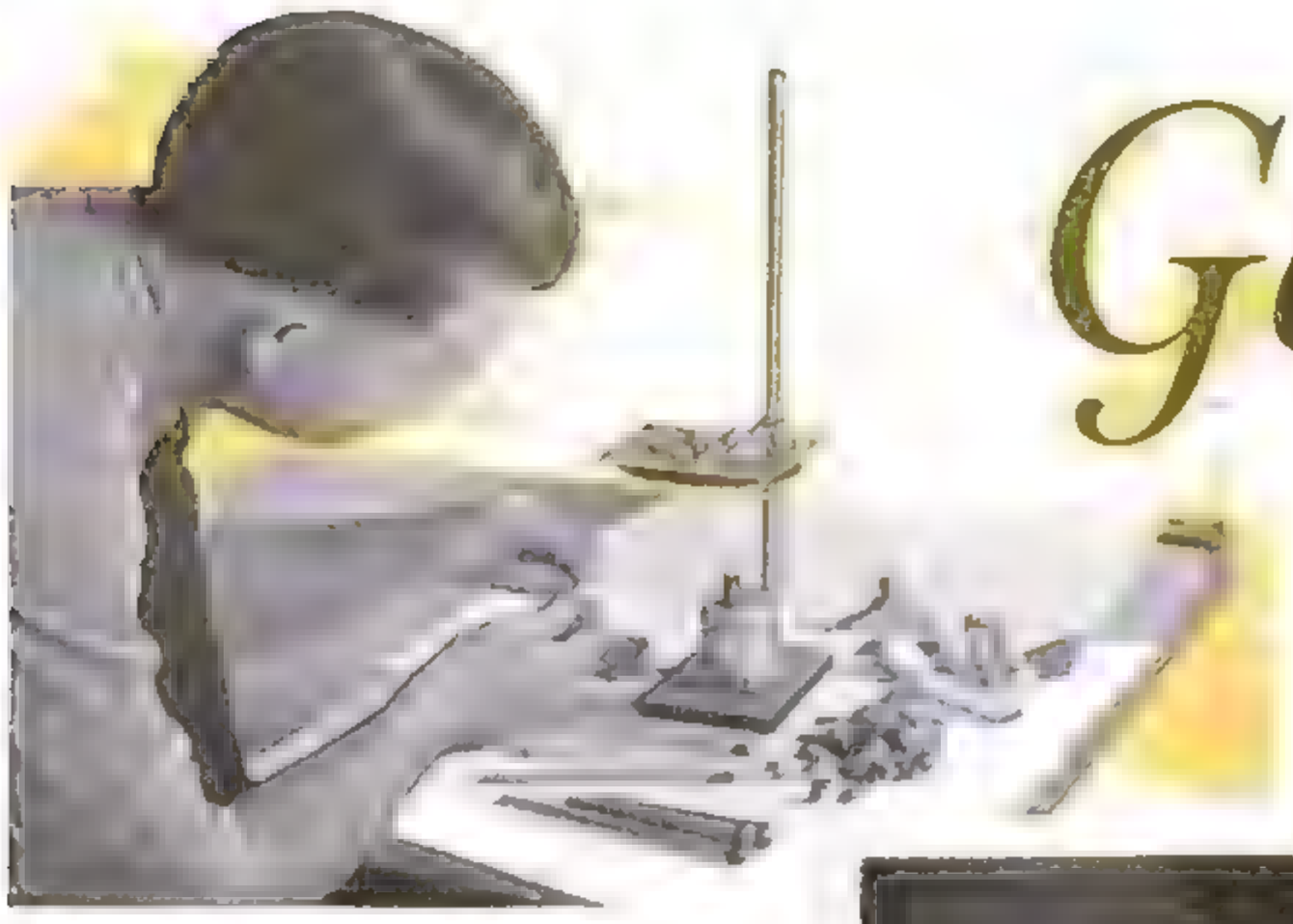
"We thought of that," said Gus. "We even went so far as to look around to see what we could pick up in the way of a secondhand truck that would be suitable. You can build a regular 'land yacht' on a truck body. But there are disadvantages to a big outfit like that. In the first place, you have to pay a whopping big license fee in most states on account of the weight. A trailer license doesn't cost much—only two dollars in Connecticut, eleven in New York, and so on—and the size or weight doesn't make any difference in the license fee in lots of states.

"Another thing: When you stop for a few days in one place and you want to take short sight-seeing trips here and there, you've got to take the whole works with you if you have a 'land yacht,' whereas with a trailer you can leave it in camp."

"Are they unhooked as easily as that?" Pendleton inquired.

"Only takes a minute or two," Gus answered. "See, here is the ball-and-socket-joint arrangement that is used in one form or another by most of the trailer makers. This jack supports the front end of *(Continued on page 132)*

By MARTIN BUNN



Gem Cutting

After the stones have been cut approximately to size, they are warmed over an alcohol lamp and cemented with sealing wax to the ends of short wooden dowels, which serve as handles in the grinding and polishing

. . . THE LATEST HOBBY FOR AMATEUR CRAFTSMEN

By W. T. BAXTER

Instructor, Art Metal and Jewelry
Woodrow Wilson High School
Washington, D. C.

Every home worker at some time or other has picked up beautiful pebbles or rocks and said to himself, "I wish I knew how to grind and polish these so that I could use them for making something worth while."

A few craftsmen, including Mr. Baxter, didn't stop at wishing. They went ahead and found out how to do it. This marked the start of a new hobby that is rapidly gaining popularity. If you want to be among the first to try it, you will find in the accompanying article the results of Mr. Baxter's many experiments and long study at the Smithsonian Institution.

BY MAKING a few simple attachments for a small wood-turning or metal-working lathe, or by using a quarter-horsepower motor, anyone can speedily learn the fascinating art of cutting and polishing semiprecious stones.

The expense for materials and equipment is relatively small, and the work is neither time consuming nor tedious. With very little practice it is possible to make an almost unlimited variety of *cabochons* —stones that are flat on the bottom and have rounded tops. These may be used in rings, pins, brooches, earrings, and other jewelry, and set as ornaments into many types of small craftwork articles, such as cigarette and jewelry boxes.

Rocks that will make excellent *cabochons* may often be picked up in gravel and from the beds of streams. In fact, suitable stones and minerals are to be found in many localities. Those who do not wish to hunt their own specimens can purchase a supply from natural science supply houses or from dealers in minerals. Considering the number of polished stones that may be obtained from a small piece, the purchased minerals are not expensive. When buying, always specify gem-cutting material To help determine if a specimen will cut into a good-looking *cabochon* and to bring out the hidden beauty and color, view the piece while wet. Other suggestions in regard to the choice of stones will be given near the end of this article.

The first step in preparing to cut and polish stones is to obtain a good silicon-carbide wheel of 100 grit with a bond suitable for cutting quartz and softer material (Quartz is seventh in hardness on Mohs's scale of hardness.) The wheel should be 1 in. thick, 8 in. in diameter, and have a hole to suit the arbor on which it is to be used. In addition, get some silicon-carbide abrasive grain in the following sizes: No. 100, FF, and No. 600.

The wheel should turn at a speed of 500 or 600 r.p.m. I made an attachment or arbor (it can be seen in the foreground of one of the photos on page 65) to hold the wheel to a faceplate, and mounted

The stone is first roughly shaped on a 100-grit wheel, which is used wet. Note the water reservoir, splash shields, and pans

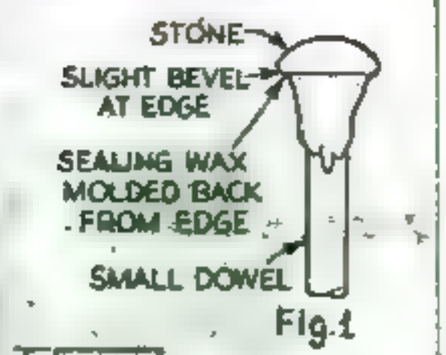


Fig. 1

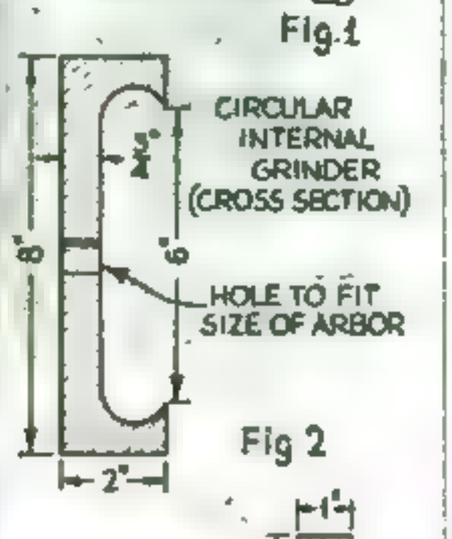


Fig 2

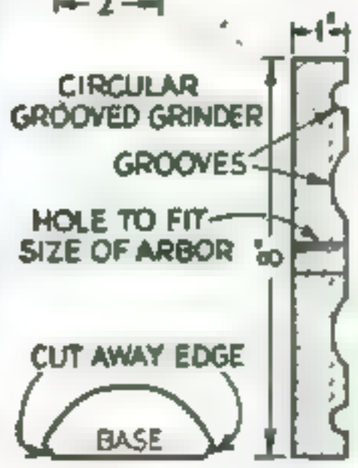


Fig. 4 Fig. 3

practically all stones, although for turquoise it is better to use the abrasive on the smooth side of buckskin or sheepskin.

The stone is now ready to be removed from the dop. Slightly warm the stone and pry it off with a knife blade. Any sealing wax remaining on the stone can be dissolved by using a cloth dampened with acetone, obtainable at drug stores. The base of the *cabochon* may now be polished. Hold the stone with the fingers or mount it on a dop with sealing wax.

Although there are several operations involved in grinding and polishing a stone, each usually requires only a few minutes. A single stone may be carried through the various operations, but it is better practice to work on several to avoid much chang-

How the internal grinder is used, first with FF abrasive and water, then with No. 600 grit

the faceplate and wheel in a lathe. Then, as it is best to run the wheel wet, I prepared a shield of galvanized iron in the shape of an inverted U and fastened it to a board as shown in several of the illustrations. A pan must be placed beneath the shield and wheel to catch the water.

Water is supplied through a rubber hose from an elevated can. I stuck a piece of copper tubing into the end of the hose and hammered the end of the tubing shut. Then I drilled a small hole in the closed end and bent the tubing at a right angle. The tubing is clamped to the top of the shield with a spring clamp or clothespin, so the stream of water can be directed wherever needed.

Select the stone to be ground and by holding it against the side of wheel, flatten one side, which is to be used as the base. Then grind the stone approximately to its intended shape.

The stone should now be slightly warmed and cemented with sealing wax or chaser's cement to what is called a "dop." A small dowel rod about the size of a pencil and 6 in. long will serve the purpose. The wax is heated and the end of the stick smeared with it. The wax-covered end is then reheated and pressed against the base of the stone. With damp fingers, mold the softened cement around the base, keeping it back from the edge, as shown in Fig. 1 of the drawings. Avoid overheating the stone; it should not be too warm to handle with the fingers.

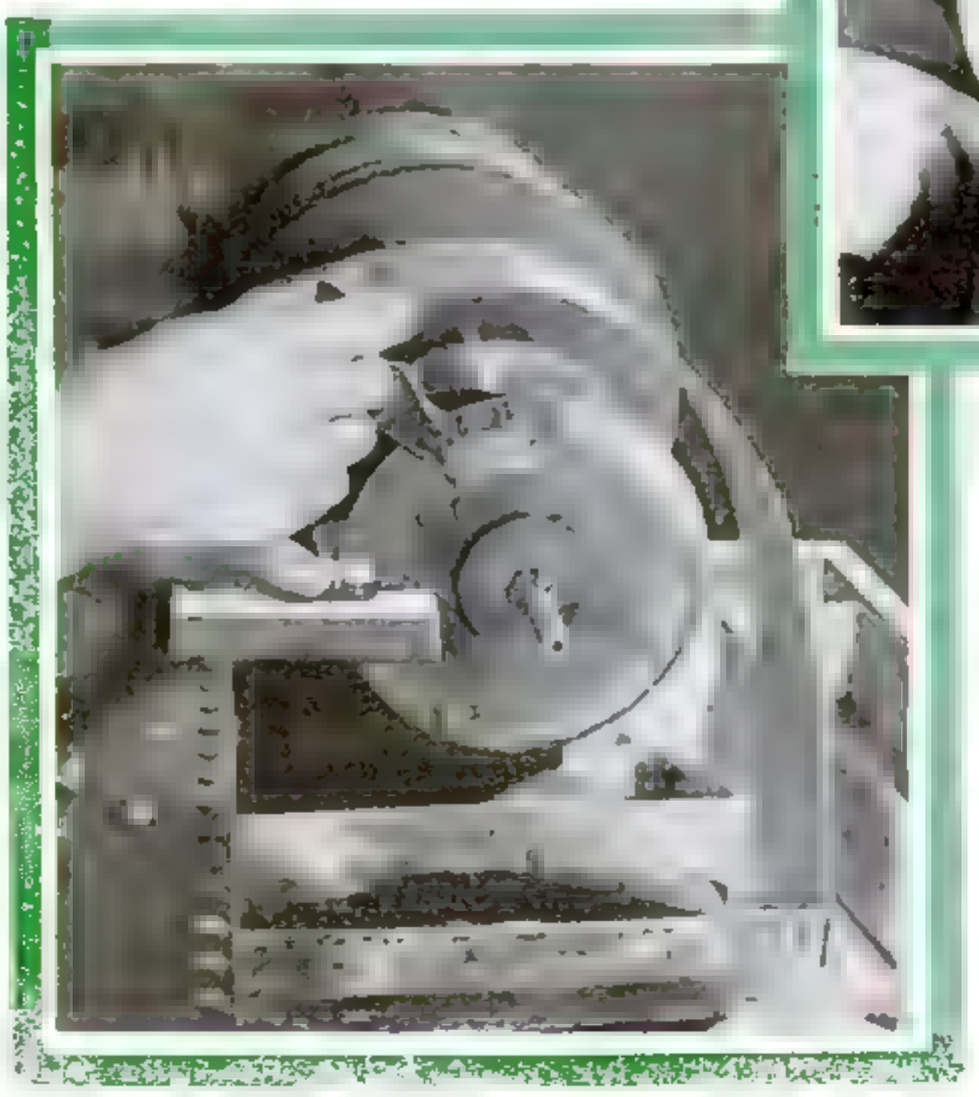
By holding the stick between the thumb and forefinger and placing the stone against the grinding wheel, the stone can easily be shaped. Twist the stick and raise and lower the end as necessary. Keep the stick constantly in motion to avoid flat places.

After the stone is shaped, the wheel is removed and a wooden internal grinder or lap, made as shown in Fig. 2, is put on. Another type of grinder that is also very good is shown in Fig. 3.

Mix some of the FF grit with water and apply a little to the wheel with a paintbrush. Then by constantly twisting and manipulating the stone against the wood, grind out the pits left by the coarser abrasive.

Using another wooden lap and No. 600 grit, repeat the operation. After this the stone should be free from all scratches and begin to take on a polish.

A hard felt wheel, or Samson cloth (billiard-table felt) glued to a smooth face, is used to give the final polish, and tin oxide and water or levigated alumina and water serve for the polishing agent. This last operation will give a very high polish to



The final polish is given with tin oxide and water applied by means of a hard felt wheel. In this instance the felt wheel has been mounted inside an internal grinder to support it properly

At left is shown the simplest way to set up an outfit for sawing a large specimen into pieces suitable for *cabochons*. The stone is pressed against a 20-gauge iron disk which runs through a slot in a piece of wood, and a paste of No. 100 abrasive and water is applied to the disk with a paintbrush

ing of equipment and to save time.

Inspect the stones frequently while grinding. This should be done when the stones are dry, as a ground stone looks polished when it is wet.

In changing from one grinding operation to another, see that the stone and dop are thoroughly washed, which is best done with a small brush. Use different brushes, of course, when applying the abrasive pastes to grinding laps, and never mix the brushes. Not a single grain of coarse abrasive must be allowed to get on a lap charged with a finer grit. As the wheel used in the first operation becomes rough and irregular through usage, dress it with a wheel dresser.

All grinding on the stone is done toward the crown of the *cabochon*, away from the edge, so as to avoid chipping. For the same reason, do not feather the edge too much. It is best to keep the edge cut as shown in Fig. 4.

If many stones are to be cut and polished, it is necessary to saw the large pieces into sizes suitable for grinding

Small and medium-sized pieces can be cut satisfactorily by placing a 9-in. disk of 20- or 22-gauge sheet iron on a shaft, and running the disk through a ¼-in. slit cut in a piece of hardwood. The wood should be placed so that its top is about on a level with the center of the disk. This piece acts as a support for the stone, which is pushed with one hand against the edge of the disk as it revolves at about 500 r.p.m. Feed 100 grit, mixed with water into a paste, onto the edge of the disk just above the stone. It is surprising how fast the disk will cut.

For large pieces that are several inches in thickness, the piece to be cut may be held on a piece of wood by thin metal straps, fastened with screws. The specimen is then mounted on a swinging arm, and some pressure is applied to the arm. In this case the disk revolves about 500 r.p.m. in a trough that holds 100 grit mixed with medium-grade oil. This type of cutting may be materially speeded up by adding to the silicon-carbide abrasive from 5 to 10 per cent of a harder 100-grit boron-carbide abrasive. The boron-carbide abrasive is next to the diamond in hardness and costs considerably more than silicon-carbide, but if time is an important element it may be profitable to use it.

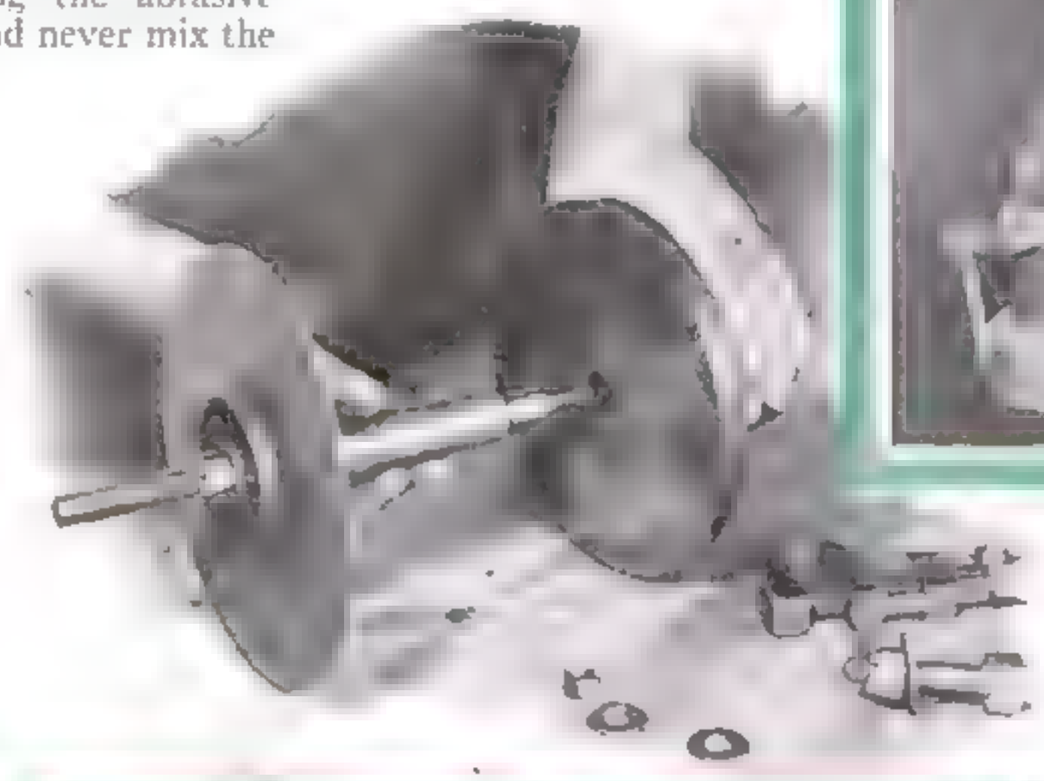
If the disk develops flats during the sawing process it can be trued by holding a piece of hard stone so that it touches the disk in the high places only. The disk must continue to revolve in the abrasive mixture while the high spots are being ground off.

Where much sawing is to be done, the two methods just described may be combined. In this case the disk revolves in a trough of oil and grit and runs through a narrow slit in a board. The direction of rotation is toward the underside of the board. The mineral to be cut is bound with thin metal straps on a piece of wood, which in turn is mounted so that it slides toward the disk. Constant pressure is applied by fastening a wire to the sliding piece of wood, running the wire over a pulley, and attaching a rock-filled bucket to the wire.

If it is desired to cut and polish a great number of stones or prepare large specimens for cabinet display, as in geological collections, an outfit like the one shown in the two lower photos on this page can be attached to a *(Continued on page 91)*

To save holding the specimen, it can be attached to a heavy swinging arm, which keeps it steadily pressed against the saw

How the sawing disk is mounted and fastened to a faceplate is shown below. In the foreground is a shorter although similar attachment for holding a grinding wheel and internal grinders



If much work is to be done, this outfit is more convenient. In the view above, the slush box has been removed to show the inside of the box and the twin vertical spindles, which are belted to run 150-200 r.p.m.

At the left the machine is being used to shape a stone on a revolving cast-iron faceplate with No. 100 grit and water. Below are details of various parts and a sketch of an alternative set-up

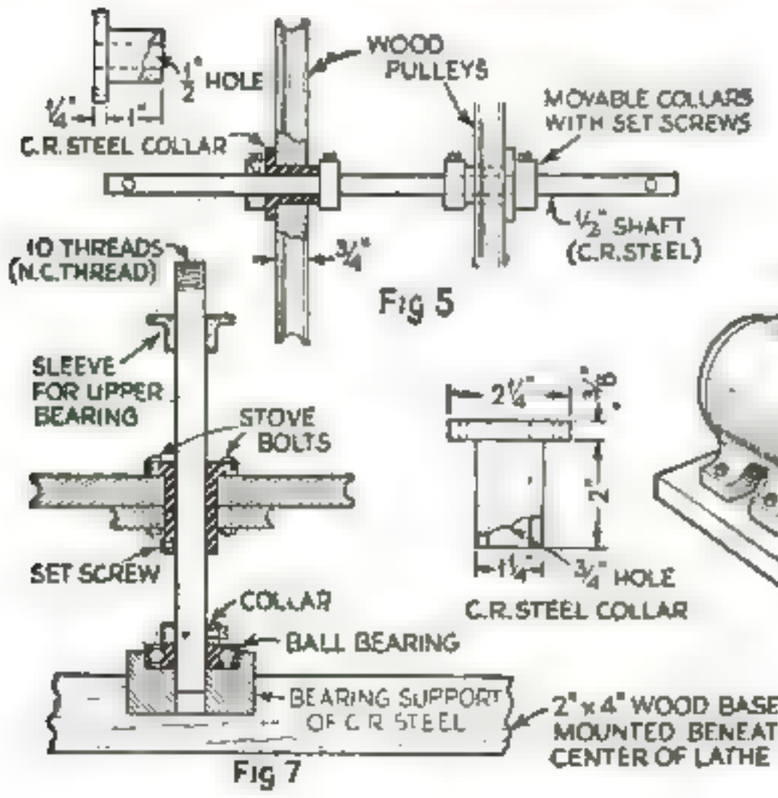


Fig 5

Fig 7

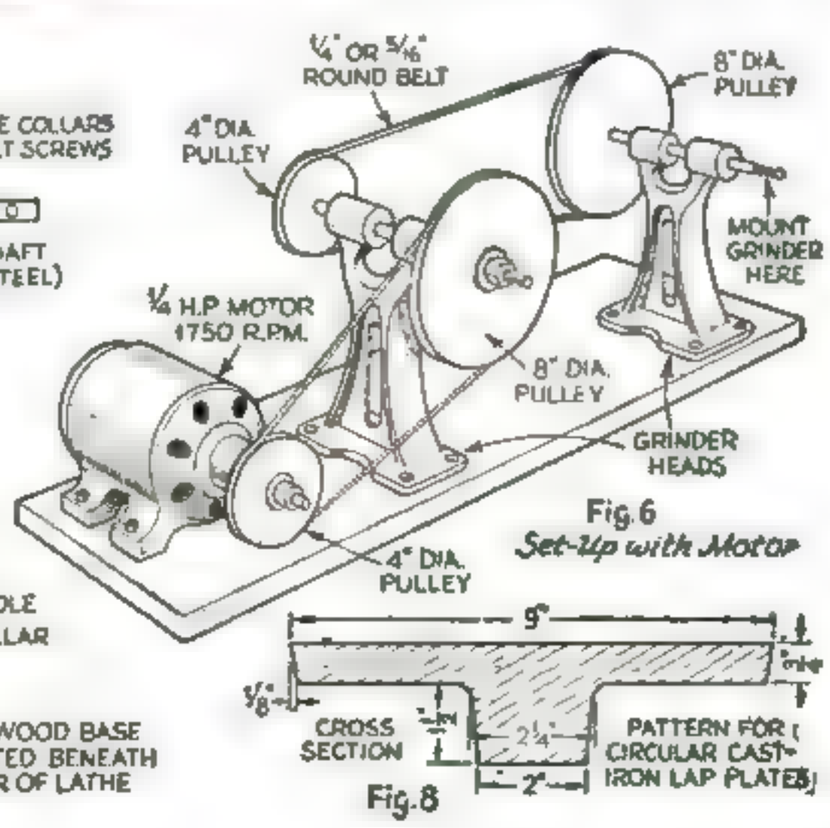
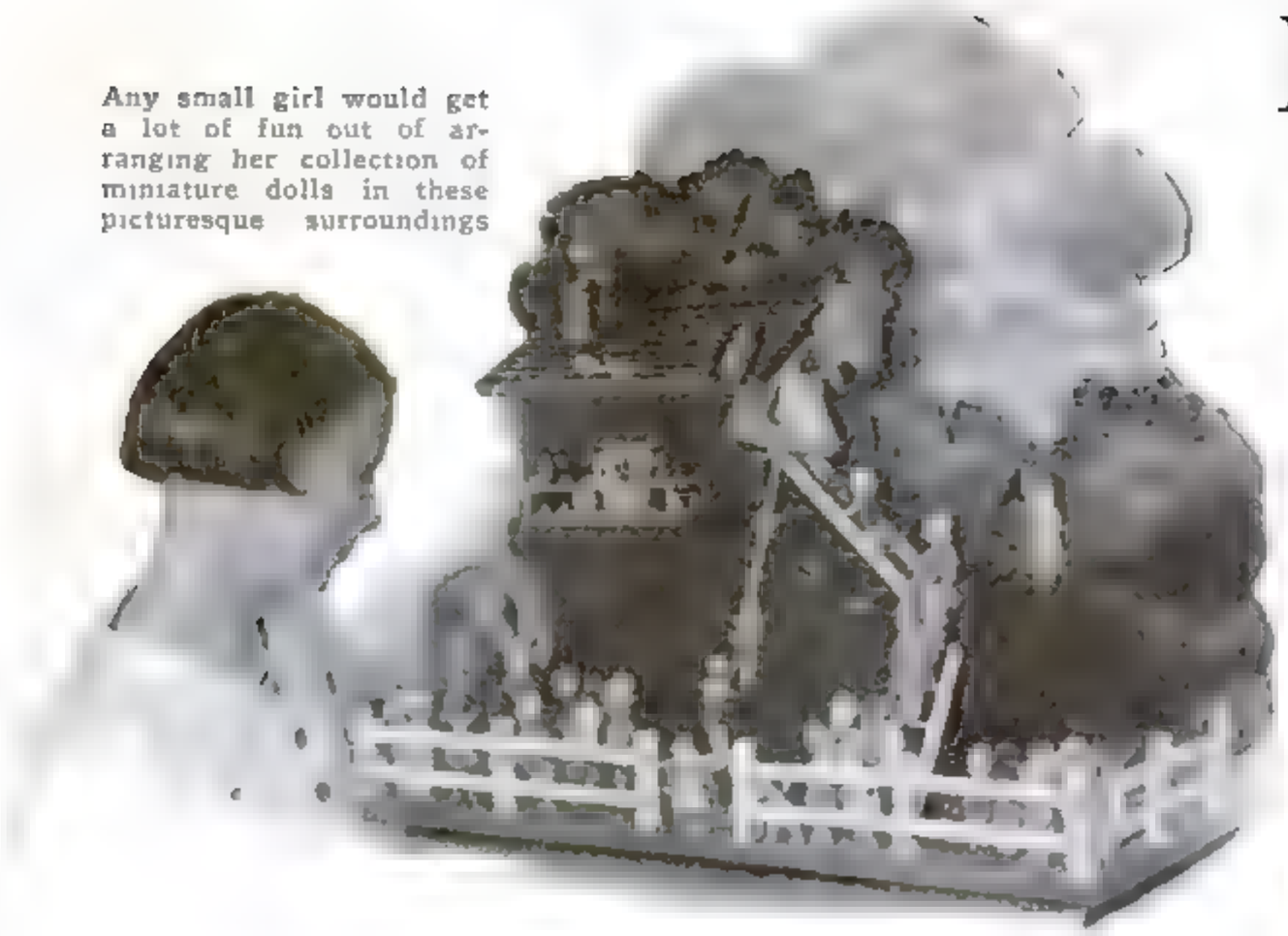


Fig. 6
Set-Up with Motor

Fig. 8

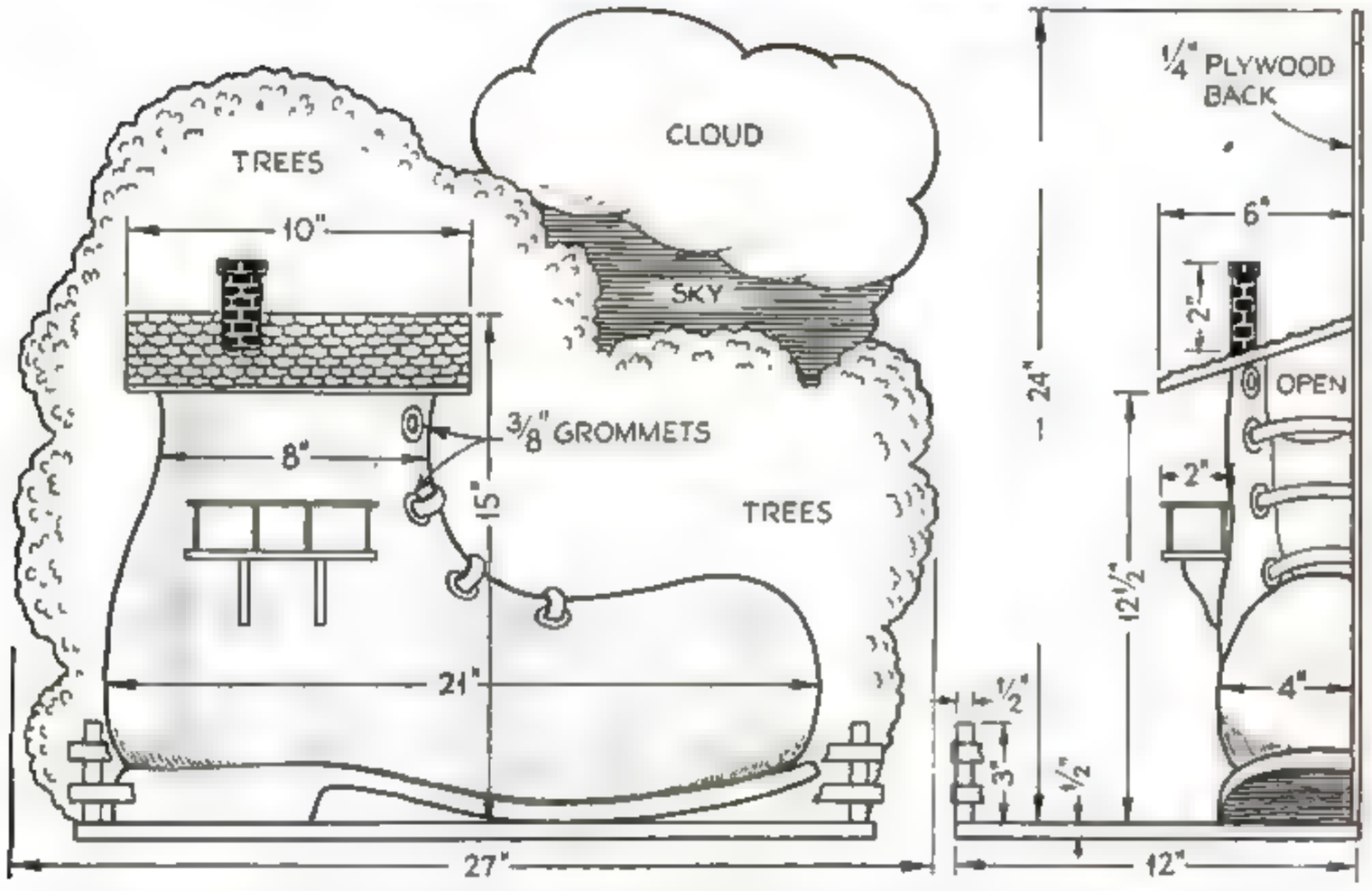
Fairy-Tale Shelf

FOR HOLDING DOLLS



Any small girl would get a lot of fun out of arranging her collection of miniature dolls in these picturesque surroundings

The dolls are arranged as if playing games. In the balcony is a tiny novelty orchestra



Front and end views of the shelf, the dimensions of which may, of course, be changed as desired

THIS whatnot shelf, "The Old Woman in the Shoe," provides a place for a girl to display her collection of miniature dolls. The dimensions are for a shelf that will hold about fifty dolls of the type illustrated.

To build the half shoe, glue up two thicknesses of white pine, unless a piece of 4-in. thick lumber can be obtained. Material may be saved if the block is made up in the form of an L with a joint lengthwise where the top of the shoe joins the long lower portion. Cut out the piece on a band saw, if available, and shape it with spokeshave and rasp. The groove between the upper and the sole is gouged out or cut with a fluting cutter in the flexible shaft. It is desirable to hollow the shoe to decrease the weight, and this may be done by boring out the inside and finishing with a gouge. It need not be a smooth job unless it is desired to add doors and windows that open.

Each eyelet is the larger half of a ⅜-in. grommet, cemented into a hole. The shoe lace may be leather or flat fiber. The finish is brown shading into black. Use paint or stain, not enamel, because the finish should not be glossy.

The back panel is cut from plywood and nailed to the shoe before the trees are drawn so they can be properly proportioned in relation to the size of the shoe. The trees and sky may be painted with enamels.

The shelf under the shoe that forms the play yard is of white pine and is nailed to the bottom of the shoe. It is painted sand color with splotches of grass green at the corners. A fence around the yard helps keep the dolls in place. The posts are ½ in. square, and the fence boards are 1 16 in. thick. They are assembled with very small nails, and the whole fence is fastened to the shelf with longer nails, driven up from the underside of the shelf.

The ladders that go up the shoe are made of white pine with match sticks for the rounds. Both fence and ladders are enameled white. The little balcony on the shoe is optional. In this model one was added to provide a place for a tiny doll orchestra. The French doors behind the balcony are merely painted on.

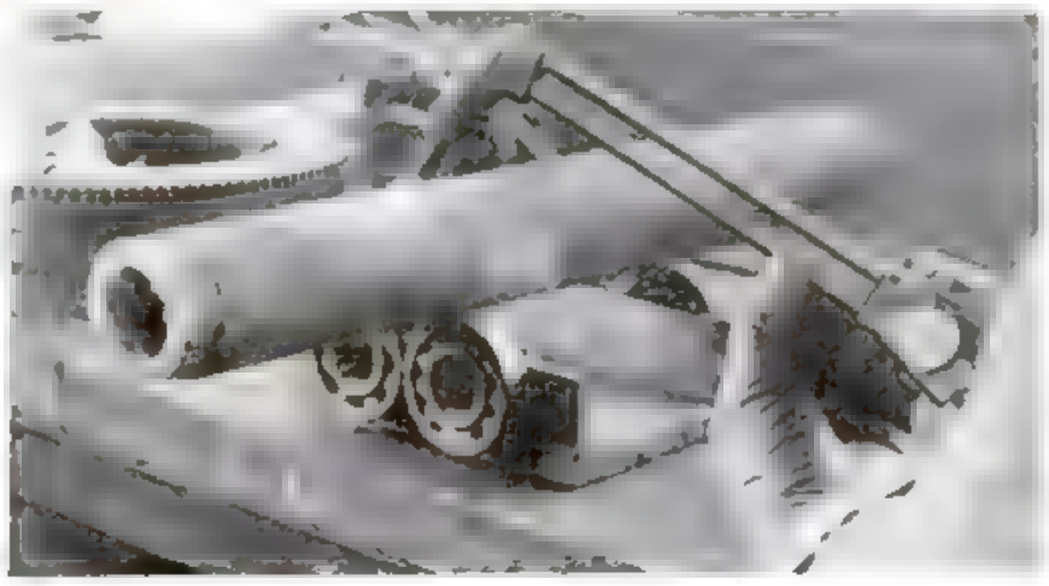
The roof and chimney also are of pine. The shingles are represented by small grooves between the courses and are given a cupped effect by gouging out the surface.

The dolls can be fastened with a bit of putty on the feet or, if greater permanence is desired, with hot sealing wax or a drop of cement. For the "Old Woman" a larger doll is used. Of course, there are various dogs and cats hiding under the shoe or lying on the roof. Most of the dolls are arranged as if playing games, but a few are climbing on the roof or sliding down the shoe lace that hangs from the upper eye.—D. C. MARSHALL.

ROUND STOCK REVOLVES ON SHOP JIG

FOR many purposes in the average shop it is desirable to have, in place of ordinary V-blocks and similar holders, a jig that will enable round stock, tubes, shafting, and the like to be revolved. Such a jig is illustrated at the right. It is made from a short section of steel channel and two ball bearings salvaged from a junked automobile. One bearing is welded on each side by means of its inner cone.

Although the jig was designed particularly for use in a welding department to facilitate both cutting and welding tubes, it is equally valuable for other operations, such as filing and sometimes even grinding the surface.—JOSEPH C. COYLE.



Made from a scrap piece of steel channel and two old ball bearings, this jig enables round stock to be turned freely for welding, filing, and other operations

Club contest night. The members put their heads together to design a prize-winning project which can be constructed within three hours

Official Magazine
POPULAR SCIENCE
MONTHLY

CASH PRIZES Offered GUILD CLUBS IN UNIQUE NEW CRAFTWORK CONTEST

Awards to be made for three-hour projects that cost less than a dollar for materials

ONE hundred dollars in cash prizes and three special plaques will be awarded by POPULAR SCIENCE MONTHLY in a new craftwork contest for clubs affiliated with the National Homeworkshop Guild.

The main purpose of the competition is to give each of the clubs an entertaining program for one or more of their regular meetings—something that will challenge their ingenuity. On these "contest nights," as they will be called, the club members will put their heads together and plan some original and interesting home workshop project that can be made in a single evening from materials costing less than a dollar. Then they will either get to work in a body and construct the article or else assign the task to one or more of their best craftsmen to be made at home. The completed article is to be sent to the headquarters of the National Homeworkshop Guild on or before February 1, 1937, for judging.

The awards will be as follows:

First prize	**$50**
Second prize	**25**
Third prize	**15**
Fourth prize	**10**
Fifth, sixth, and seventh prizes	**plaques**

Win or lose, the clubs will get a lot of fun working out this problem. They will develop a number of ideas for unusually good projects and will learn a good deal about using inexpensive materials to the best advantage. When the prize-winning designs have been chosen, each will be illustrated and described in the magazine for the benefit of all readers who like to build such projects. In this way the contest will help many more than those who actually take part in it.

"Oh, that's fine," you may say, "but I'd like to get into the contest itself, not merely read about it, and I can't because I don't belong to a Guild club."

In that case, why don't you join one or organize one yourself? If you are interested in the home workshop, you should certainly be a member of the Guild. This new contest is just one of the many opportunities you are missing, because the Guild provides a number of free services (see P.S.M., Nov. '36, p. 69) and is constantly expanding its activities. Either join a local Guild club if there is one in your neighborhood, or organize one yourself. Complete information can be obtained by using the coupon.

The rules for the contest are as follows:

Projects may be of any type, provided they can be constructed and fully assembled by one man within three hours (not including the time required for painting or varnishing) and cost less than one dollar for raw materials when purchased new. The design must be original—not taken from a published source. The project may be constructed by one, several, or all the members of the club, but it must be entered by the club itself. All projects must be shipped, fully prepaid, to the National Homeworkshop Guild, 347 Fourth Avenue, New York, on or before February 1, 1937. The judges will be the home workshop and technical editors of POPULAR SCIENCE MONTHLY, and their decisions will be final. In case of ties, each tying contestant will be awarded the prize tied for. A club may submit more than one project, if desired, but not more than one prize will be awarded to any one club. No projects will be returned.

(See page 96 for news of the Guild clubs.)

National Homeworkshop Guild
347 Fourth Avenue, New York

I don't want to miss the free services, contests, and other opportunities that come to members of the Guild. Without cost or obligation, please send me complete instructions on how to organize a home workshop club in my own neighborhood. Include a copy of a model constitution and an application blank for a free charter in the National Homeworkshop Guild. I am inclosing a large (legal size) envelope, self-addressed and bearing a three-cent stamp for your use in sending all this material.

NAME.....

ADDRESS .....

CITY..... STATE.....
(Please print very clearly)

SHARPEN YOUR KNIFE FOR

Gaspard the Sailor

IT'S NO TRICK AT ALL TO WHITTLE HIM OUT OF A BLOCK OF WHITE PINE

By E. J. Tangerman

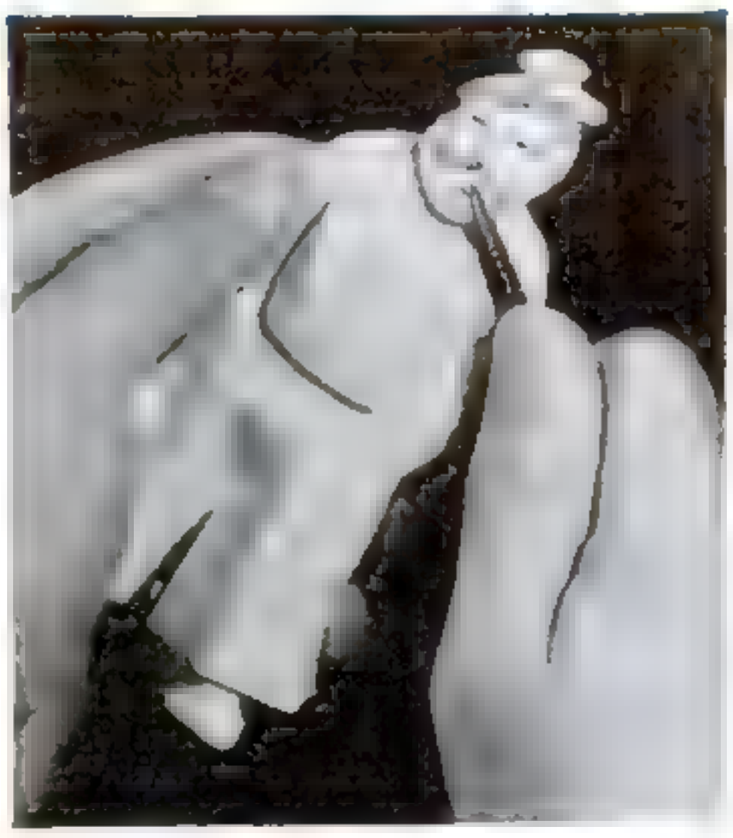
Here is Gaspard himself, smoking a pipe. At the left are two variations of the figure and a third block in the roughly whittled stage

GASPARD, typical Breton sailor, is another pleasing but simple whittled figure similar to the now famous Skipper Sam'l (P.S.M., July '35, p. 63). He has a jaunty cocksureness and a mariner's spread-legged stance. With slight changes, too, he can become a canny Scot with a gleam in his eye, lean or portly, as you prefer.

The drawings, Fig. 1, give front, side, and rear views of the basic figure. You will need a piece of soft, straight-grained white pine or basswood 1½ by 2½ by 5¼ in. (finished size). On the front and left side lay out a checkerboard of ¼-in. squares, and on it carefully copy the figure outlines, square by square.

Saw out around the head and shoulders, up between the legs, and up the outside of the trousers from the cuffs and down from the elbows, but stop cutting about ¼ in. before the cuts meet, so that the waste wood will be held in place to preserve guide lines until the front cuts are made.

Next cut cross lines in ¼ in. at the lower line of the blouse in front, ⅛ in. in back, ¼ in. at the seat of the pants, and ⅜ in. at the point of the chin (which is down 1¼ in. from the top of the head). Saw off long, wide, tapering wedges up the chest from the blouse bottom, up the trousers from the cuffs in front and back,



Front view of the figure as it appears when complete except for neckerchief and wrinkles

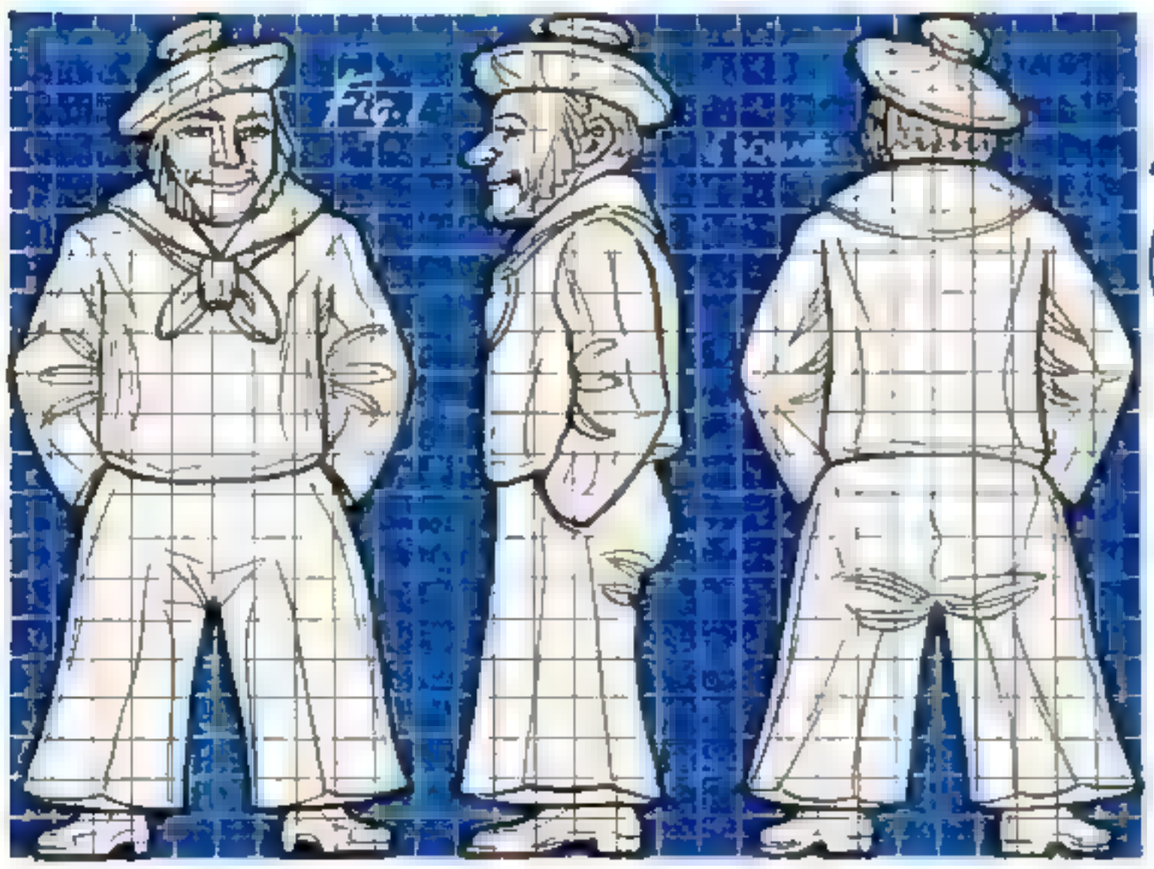
and a straight cut to the waist in back from the bag in Gaspard's trousers. Cut in horizontally ⅛ in. below his trouser cuff to separate his shoes and pants, then finish sawing off the waste wood at the sides. This will give you the blank about as shown in Fig. 2.

From here on you'll need a sharp knife, a little patience, and plenty of care. Sketch the front and back crease lines of Gaspard's pants and his blouse cuffs; then chamfer off the corners (don't cut away his sleeves!) and shape up the bottoms of his pants. Form the heels of his shoes at the *inner* back edges of the foot blanks. Cut wedges of wood on the inside front and outside back to make him toe outward. Round up the shoe fronts and cut small notches to simulate the meeting of sole and heel.

Cut four tapered, radiating grooves to represent wrinkles at the crotch in front, and round up roughly the seat of his pants. A horizontal notch across the crease on each leg will represent the pants-leg wrinkles.

Sketch the arm outline on each side, or lay out a pattern from Fig. 1 on heavy paper or light cardboard, cut it out carefully, and use it as a template to trace around. Sketch vertical lines 1¼ in. apart in front and back to represent the sides of his blouse. Now, with the point of the knife, cut in deeply on these lines, removing wedges and splitting off small sections until the arms stand out sharply and clearly from the sides. Chamfer the outer edge of Gaspard's sleeves as you did his trousers, except that the cuts should be much rougher to represent blouse wrinkles. Round up his shoulders and the body of his blouse, and the figure itself is ready for finishing

Before start- *(Continued on page 103)*



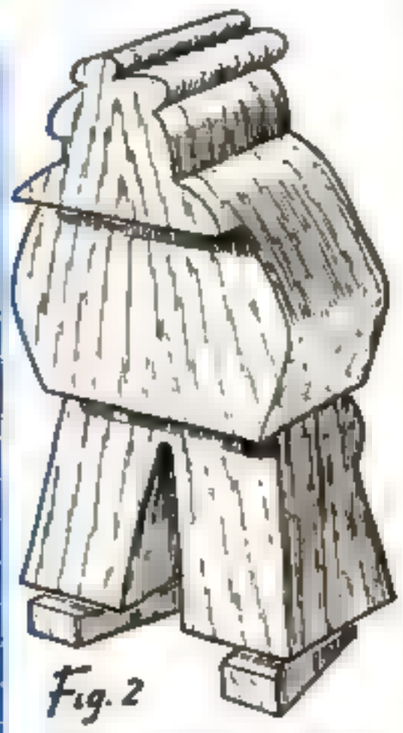
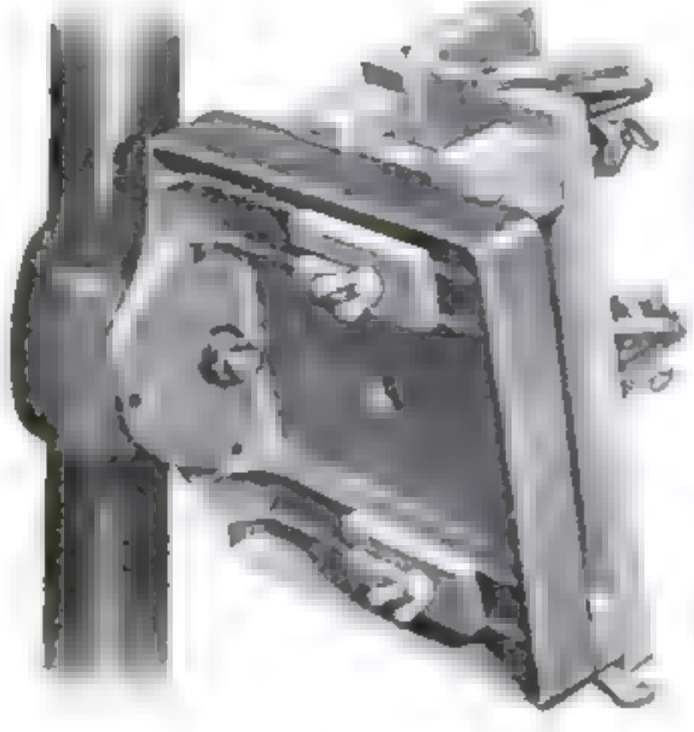


Fig. 2

The drawings, made on ¼-in. squares for easy enlargement, and a sketch of the block after being sawed out

Reversible Mortising Jig

Saves Time and Insures Accuracy



Once the jig has been correctly set, it is necessary only to start mortising and move the piece as far as it will go. At the left is shown how the jig is clamped on. Note the end stops for centering the device on the drill-press table. To remove the jig, the wing nuts are loosened and the two long wooden "washers" slipped out of place, freeing the whole

HERE is a simple jig for drill-press mortising that makes it unnecessary to do any laying out on the work, and absolute accuracy is assured in cutting, since stops automatically locate the mortise and limit their length. Furthermore, the stop slide can be instantly reversed for mortising pairs of legs, without changing the setup in any way.

The jig base is a piece of 1 by 6-in. lumber screwed to the regular fence supplied with the machine. Counterbore the clamp-bolt holes to sink the heads flush. The two cleats beneath the base have notches, which act as runs for the stop slide. Before screwing them on, groove the underside of the base to allow passage of the tail stop and its clamp screw when mounted on the slide. Space the cleats from outside to outside equal to the table width, with the same base projection at each end. This is very important. Nail or screw to each cleat a plywood stop projecting ¼ in. below, to catch the table edges, thus centering the jig as it is put on the drill-press table.

The slide is a piece of dressed 1 by 2-in. wood of any convenient length. Screw a fixed stop to one end, using a cardboard shim between the pieces to raise the top of the stop a little above the jig base. Make a movable head stop as shown to clamp on top of the fixed stop. A similar but smaller forked plywood strip serves as a tail stop.

Make two plywood dogs or catches to pivot on the jig ends, as in the drawing, notching the ends to clasp over nails driven into the jig.

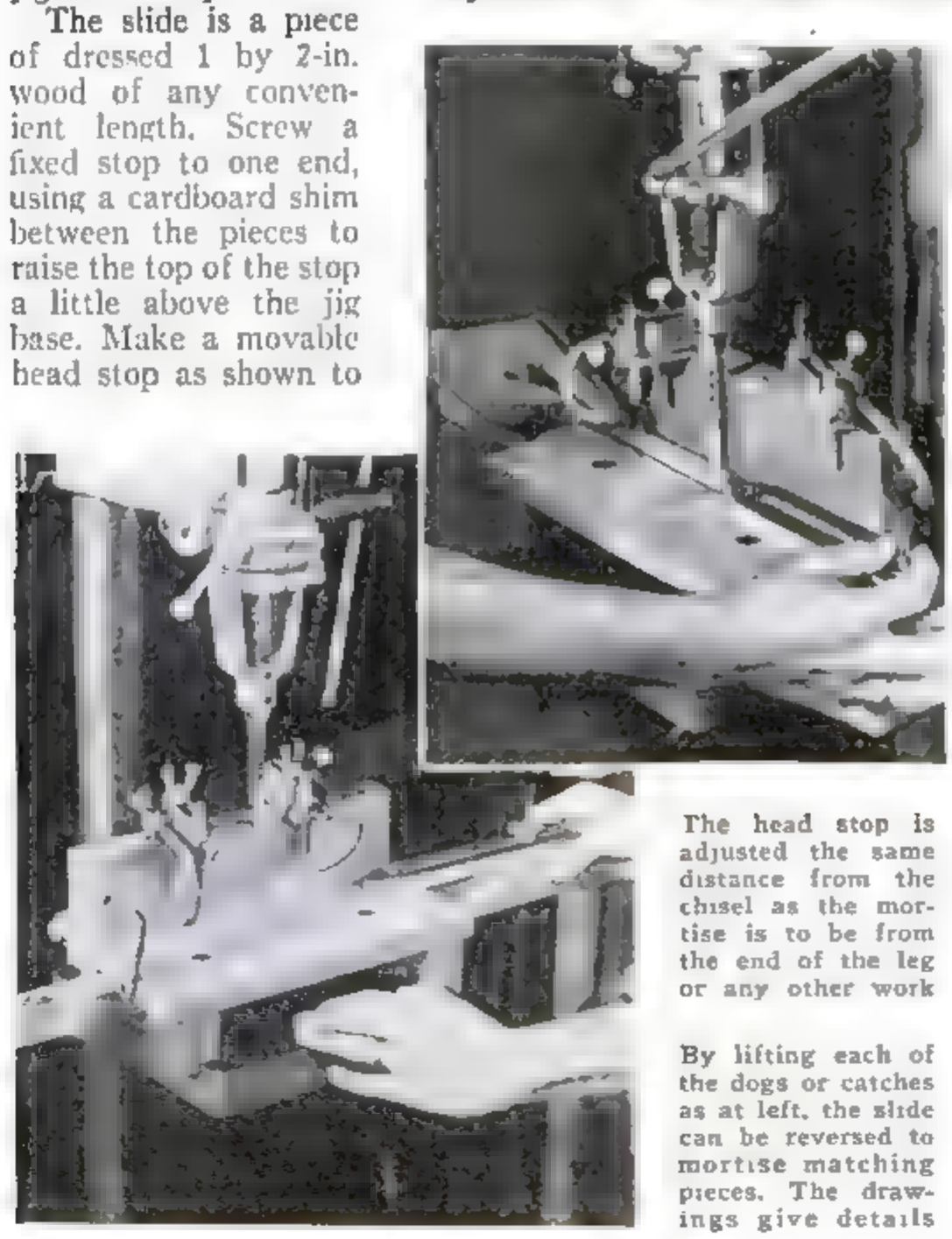
To help in centering the jig on the mortising chisel, square a center line out from the fence on the base, and draw lines each side, as shown below, to indicate where the sides of chisels of various sizes come.

Place the jig on the table, slip the forked "washers" between the bottom of the table and the wing nuts, lower the chisel, and swivel the table to center the jig. Next, slide the jig forward or backward until the distance from the chisel to the fence equals the distance of the mortise from the face side of the work. Lift the stop dogs, insert the slide from the right end, drop the dogs, and push the fixed head stop against its dog. Holding the slide, move the head stop until the end is as far from the chisel as the mortise is to be from the end of the work, and clamp it with the wing nut. Finally, adjust the tail stop the same distance from its dog as the length of the mortise is to be.

Lay the piece to be mortised on the jig, one face down and the other against the fence. After adjusting the hold-downs, press the end of the piece against the stop and move it, together with the slide, to the left until the fixed stop prevents further motion. Start mortising and move the piece until the tail stop engages, when the job is done.

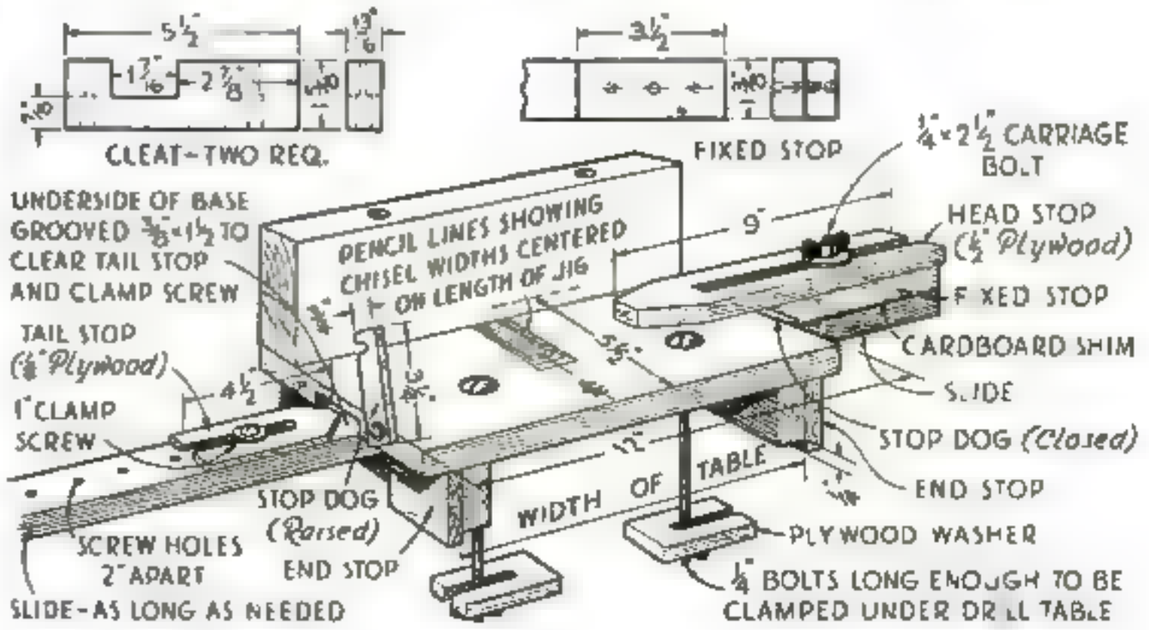
If additional mating pieces for the other end of a frame are to be mortised, finish the first, lift the dogs, and reverse the slide, using the head stop against the left end of the jig. This allows the face sides to bear against the base and fence again. Of course, if table legs are being mortised, everything will be gone over with the slide reversed.

If the legs are of the cabriole type, or have turned portions larger than the square sections, block the squares up with strips of wood. Then proceed as previously described.



The head stop is adjusted the same distance from the chisel as the mortise is to be from the end of the leg or any other work

By lifting each of the dogs or catches as at left, the slide can be reversed to mortise matching pieces. The drawings give details



Electric Teacher Helps Memorize

CONSTRUCTED by a student to lessen the drudgery of learning Latin words and their English equivalents, this electric teaching device was found so practical that several of them have been built. The same method could be used in memorizing all sorts of facts, or it could be adapted for playing various games.

Two columns of words are typed on cards and attached to the board as shown. Opposite each word is a brass paper fastener, which acts as a contact. One electrode is then pressed against a contact, and an effort is made to touch the other electrode to the contact in the adjoining column which is opposite the Latin or English equivalent of the first word. If this is done correctly, a light in the center of the the board flashes on. When the lists are thoroughly memorized, the cards can be exchanged for others bearing different words.

To make the device, cut a piece of composition board to fit inside a shallow cardboard shirt box or any similar box. Make two rows of holes for the contacts, spaced to correspond to double-spaced typewriting, and insert a brass paper fastener in each. Remove the coat of lacquer from the top of each fastener with a file and bend the halves apart on the other side. Short lengths of bell wire are carried haphazardly across from the fasteners in one row to those in the other, and the connections are soldered.

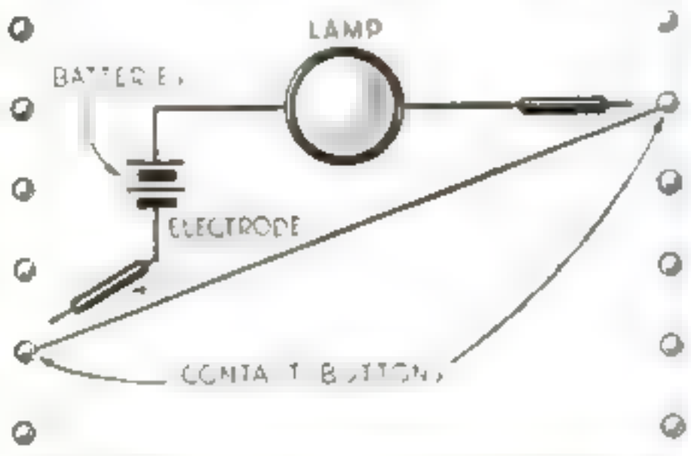
Fasten two dry-cell batteries under the board with clips as shown, and wire them in series with the light and two electrodes. The lamp is the top of an old flash light. It is preferable to exchange the regular bullseye lens for a red reflecting warning lens from a bicycle tail lamp. The electrodes are pointed pieces of heavy (No. 10) copper wire inserted in suitable wooden holders, which may be short lengths of pencil from which the lead has been removed. Use flexible wires for the electrode connections.

Fit the completed device in the box to make a presentable appearance. In order that they may readily be changed, the name cards can be held to the front of the board with mounting corners such as are used to fix photographs in albums.

When the corresponding contacts become too familiar for the device to be a helpful teacher, it is an easy matter to take the apparatus out of the box, disconnect the bell wires on one side, and fasten them to different contact buttons, making a new setup.—CLIFFORD LEESTMA.

One point is touched to the contact alongside the English word, the other, to its Latin equivalent. Then the light flashes on

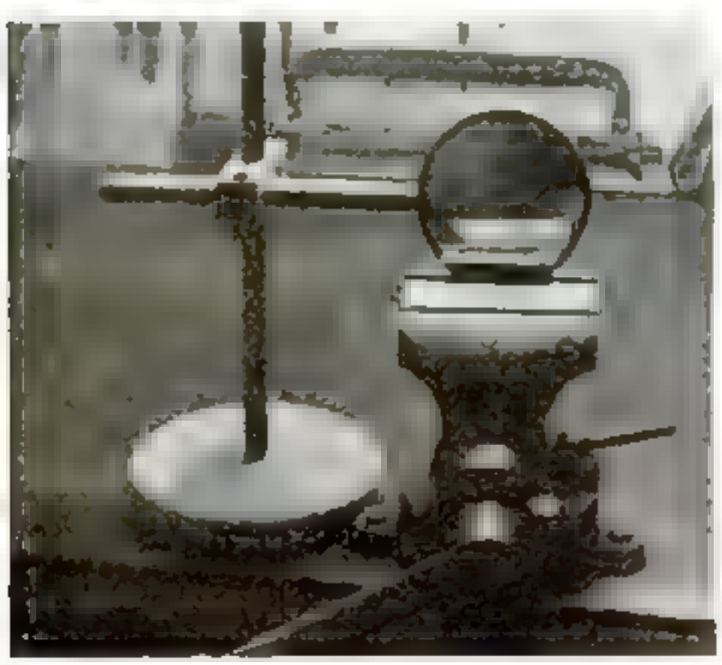
Two typewritten lists are placed on the device, and the student tries to pair off the various terms correctly



This diagram shows the general method of wiring. Each contact on one side is connected in haphazard fashion to a contact on the other side, as indicated at right

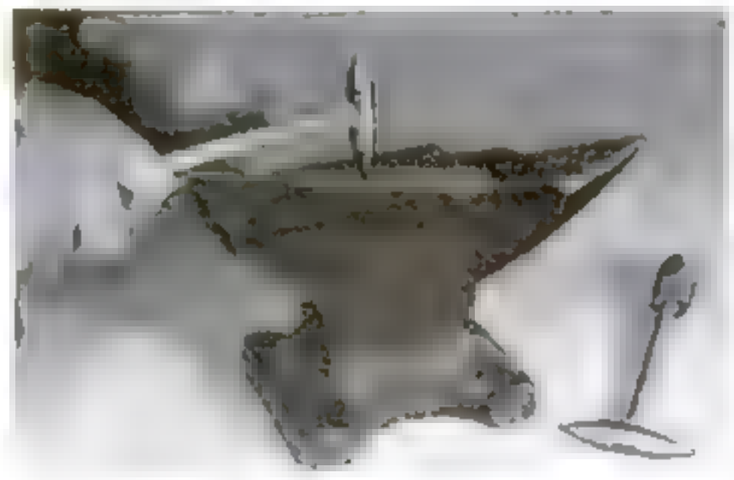
TEN-CENT MIRRORS AID IN SHOPWORK

SMALL mirrors, both plane and concave, are helpful in the shop. Ordinary flat mirrors can be used to locate small objects that have dropped into corners by reflecting the light from overhead.



A concave mirror, such as the complexion or shaving mirrors sold in ten-cent stores, gives an intense beam of light at the focus. The focal point of this type of mirror—the distance from the mirror at which distant objects are brought to a sharp focus—is usually about 10 in. This makes it ideal for use at the lathe or milling machine when resetting the tool or cutter up to a shoulder or into a thread. In such a case, the mirror is mounted on a stand so that it can be placed under the tool to reflect the light upward. How the concave mirror and stand are used when filing to a line is illustrated at the left. In this way the mechanic can see at all times how close he is to the line without bending over.

Other uses include the viewing and illuminating of the inside of cylinders, borings, internal threads, and similar hard-to-get-at places.—HOWARD C. LINDEMANN.



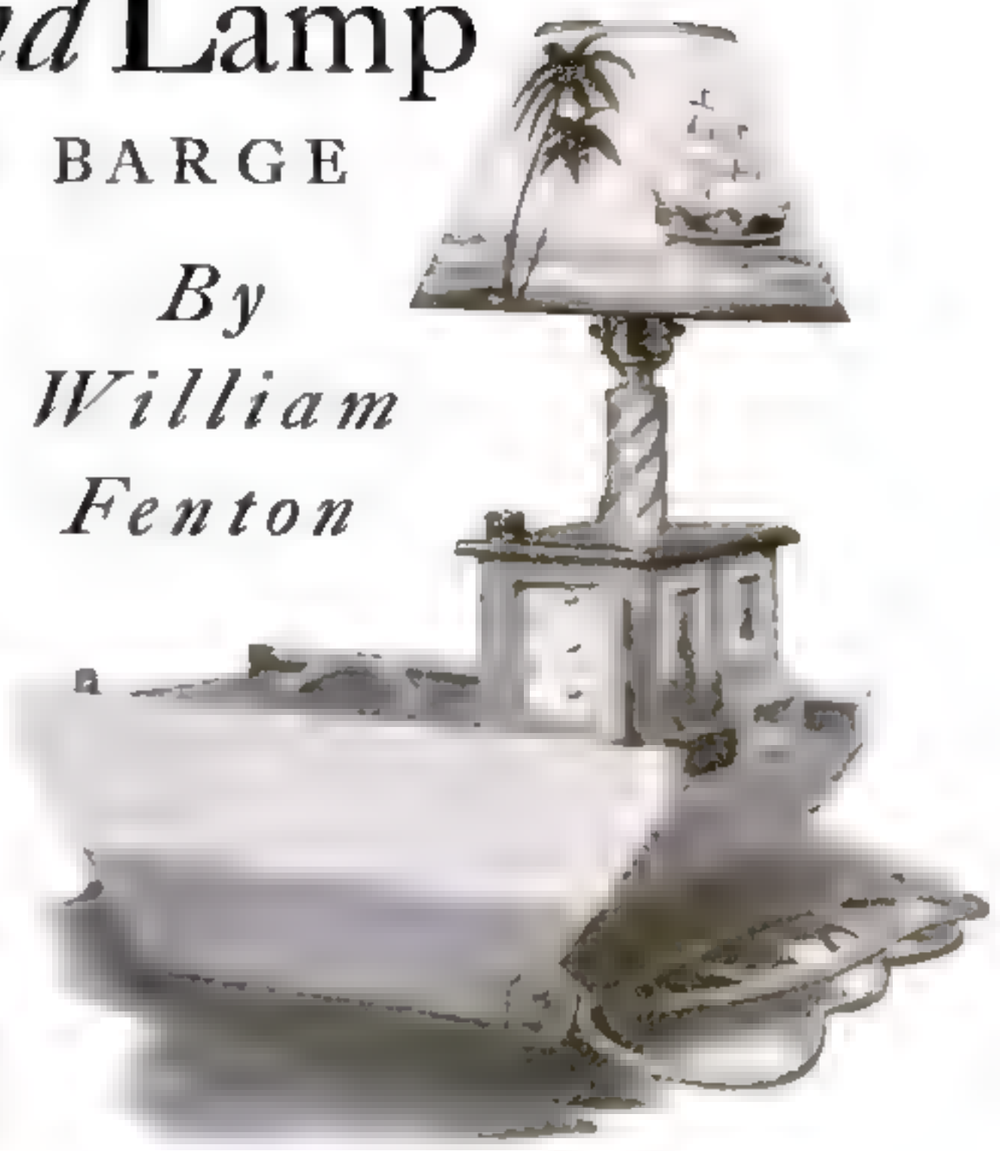
HANDY SPOTTING HAMMER

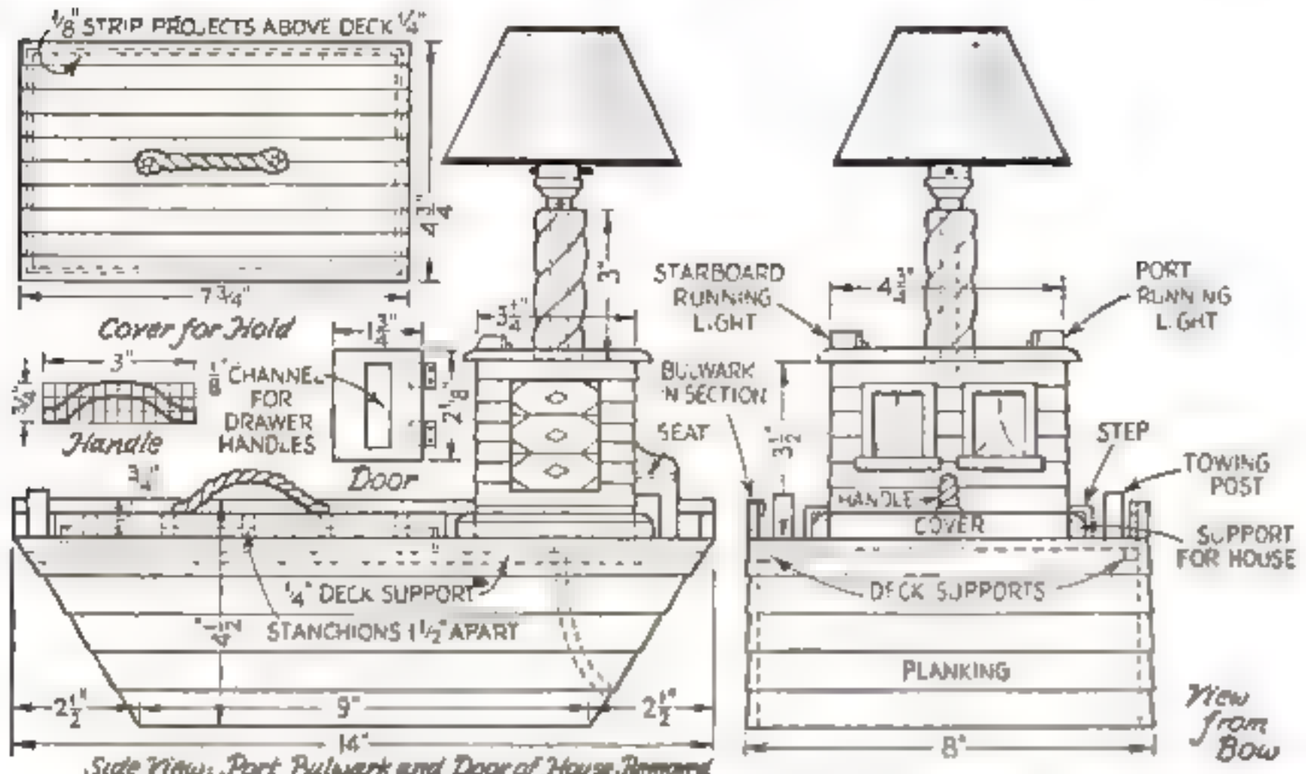
SMALL hammers for spotting or hammering copper, brass, and silver objects can be made from round tool steel. The two hammers shown were made from 3-in. lengths of 5/8-in. diameter tool steel. The ends were turned down, and the tip rounded with a file. The eye for the handle was formed by drilling two holes and filing out the metal. Harden by heating the steel to a cherry red and dropping in oil or water.

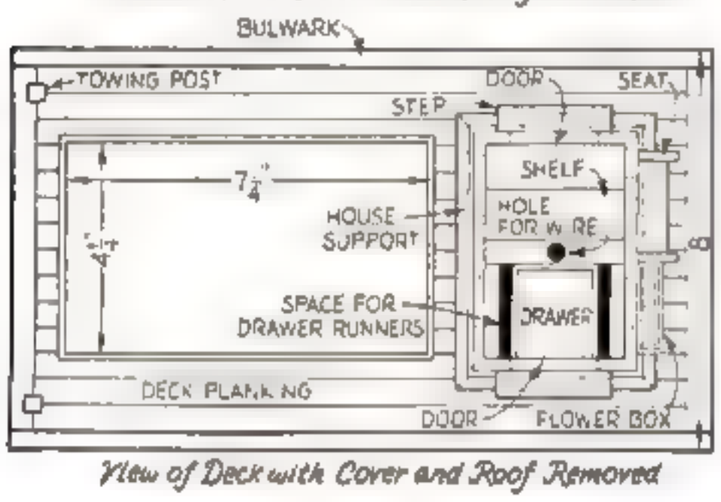
Unique Sewing Box *and* Lamp

RESEMBLES MINIATURE BARGE

By William Fenton







Here is a novel combination sewing box and lamp. The sewing materials are kept in the hold; thread and all small accessories, in the deck house

SEWING boxes always make welcome gifts, especially if they are designed with some degree of originality and novelty. In the example illustrated above, the box itself is constructed in the form of a barge or lighter. The sewing materials are stowed below deck in the hold, and spools of thread, needles, and small accessories are kept in the deck house, which also supports an electric lamp.

The drawings give all essential details of the construction. Nearly all the main pieces are made of ¼-in. basswood. Glue and nail the hull together and place two ¼-in. square strips 1 in. from the top of the inner sides to support the deck. The opening in the deck begins 1 in. from the bow, with a margin of 1½ in. on the sides. Glue strips ½ by ⅛ in. around this opening, projecting ¼ in. above the deck, to hold the cover in place.

To imitate planking, mark lines around the hull ¾ in. apart with a rule and a sharp knife, making the incisions fairly deep; then use a chisel to bevel one edge under the other. Make the planking marks on the deck and house about ½ in. apart.

The supports for the deck house are made of ⅜-in. pine, the back support being 1⅛ in. from the stern. When cutting the doors, allow a ⅞-in. margin at the base in order to clear the bulwarks. Celluloid or glass is used for the windows, and the curtains are painted on.

The two compartments of the house are separated with a piece of ½-in. pine, 2¾ by 3½ in., with a hole drilled through to take the wiring. In the compartment on the starboard (right) side, glue a shelf for holding small spools of thread. For the port side, cut two pieces 1⅞ by 3½ in. and glue them between the wall and the center division. Attach runners and make the drawers of ⅛-in. balsa, using model airplane (cellulose) cement. The handles are also ⅛-in. balsa, cut diamond shape. A vertical channel or pocket must be cut in the inside of the door as shown to fit over these handles. A seat and flower box may be built on the stern.

Both the cover handle and the 1-in. post for the lamp are pieces of wood carved to represent rope.

The hull is painted green to the water line and white above. The deck is stained walnut. The framework of the deck house is green; window frames, white; supports around house, white; seat, green; flower box, red; roof, black; column for lamp and cover handle, gold; drawer handles and corners of drawers, gold; port running light, red; starboard, green.

ICE-SKATE PROTECTORS

TO PROTECT the runners of ice skates from becoming nicked, obtain two pieces of old auto-tire inflating hose about 1½ in. longer than the blades. Slit the hose up to within ¾ in. of one end. Spread the hose and draw it on the blade, pulling the solid uncut portion snugly up against the nose of the runner, and press the hose firmly down along the blade. Being quite thick and heavy, the hose grips the sides of the runner firmly.—FRANK BENTLEY.

TRUING A UNIVERSAL LATHE CHUCK

A THREE-JAWED universal chuck is one of the most convenient tools for the workshop, but very few will hold work absolutely true. The following method, if carefully followed, will grind the jaws so accurately that it will be possible to remove and replace work in the chuck and yet have it run true after each shift.

Remove the jaws from the chuck and clean them with kerosene; then clean the scroll thread in the chuck and remove any grit or cuttings. Relieve the back of the jaws for a length of ½ in. and a depth of 1/16 in. by grinding. Except for appearance, this operation need not be done with any great accuracy. Replace the jaws and grip a washer or "hex" nut tightly in the relieved part. Fasten a pocket oilstone to a boring bar, set it at a slight angle so the leading end is in contact with the jaws, speed up the lathe, and cut very lightly back and forth.

The back of each chuck jaw is relieved slightly as at the left; then the truing is done with a pocket oilstone fastened to a boring bar

Secrets of Constructing an

Ultramodern

The best indoor models now weigh as little as six hundredths of an ounce and fly for as long as twenty-four minutes at a speed of about two miles an hour

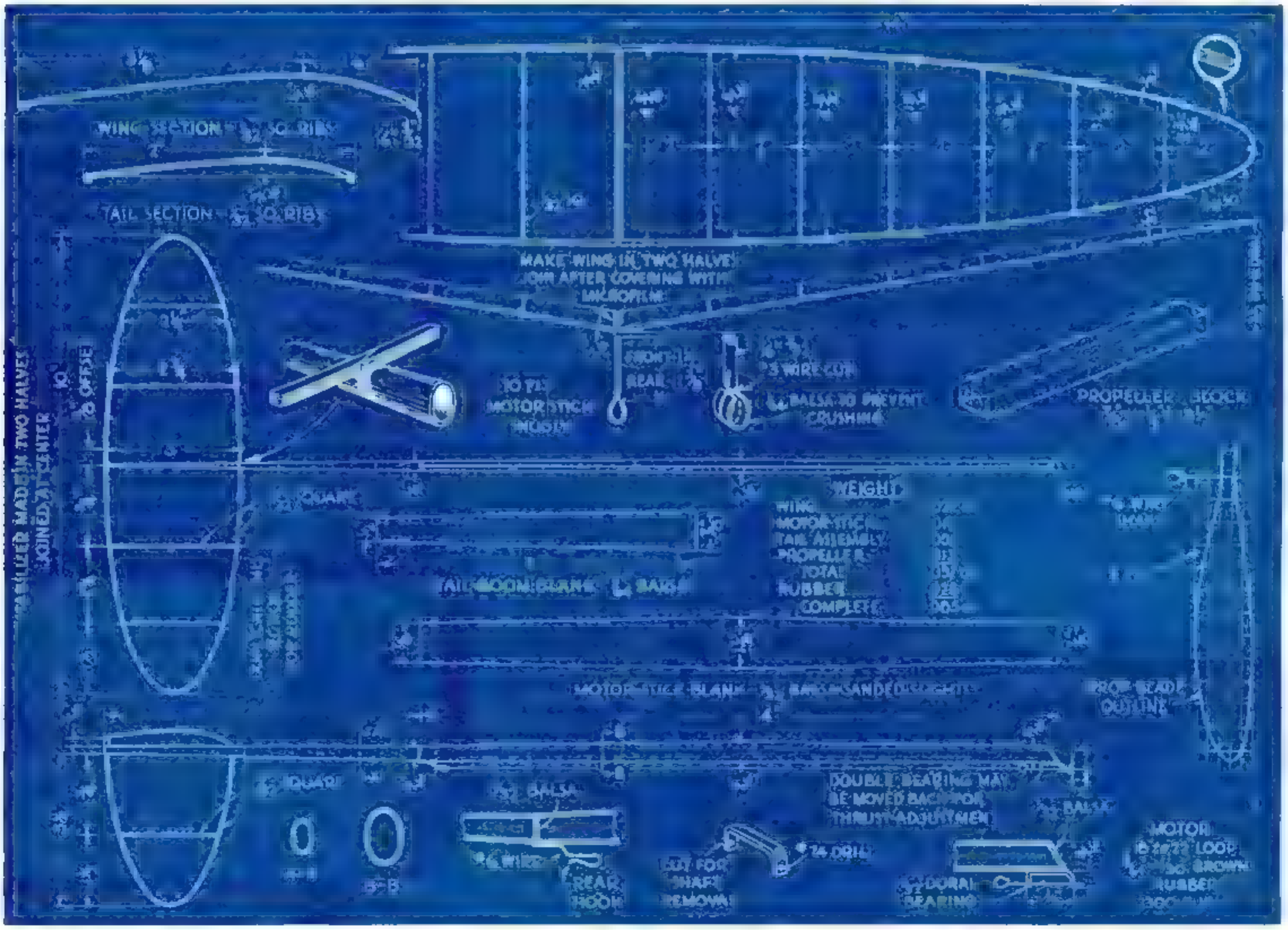
"SPEED and more speed" is the cry of the modern aeronautical engineer, but not the model builder. "Give me slowness!" he breathlessly demands as he watches his ghostlike model fly in the dimness of a silent armory. He talks in terms of two miles an hour while the engineer scorns two miles a minute.

The average speed of an indoor model has dropped from five miles an hour in 1927 to about two at the present time. And the endurance of the flight has jumped from three minutes to twenty-four. The chances of breaking a world record are much better with a slow model because the speed depends on how fast the propeller is turning, and since the number of turns that can be placed in a rubber motor is limited to about 2,300, it can readily be seen that the power must be conserved by slow-turning propellers.

Another factor is lightness. The early designs weighed about .25 oz. while present models of approximately the same wing area weigh only .06 oz. Four times lighter!

To make a model light and strong enough to take care of rubber motor torque and necessary handling, the model builder takes advantage of several structural combinations. The spars are made so that the widest part takes the load. Wherever possible, the wood members are made of balsa tubing having a wall thickness of from 1/32 to 1/64 in. The ribs of the wing and tail are cambered to obtain better lift and to take advantage of the fact that a slightly concave section is stronger than a flat one.

The balsa wood used on indoor models must be of the lightest stock obtainable—not more than 5 lb. a cubic foot. It should be cut along specific grain lines to take advantage of its natural qualities. Wood cut parallel with line A-A in the diagram of a log cross section on page 120 can be easily bent for motor sticks and other tubular parts because the texture is of the same year's growth and



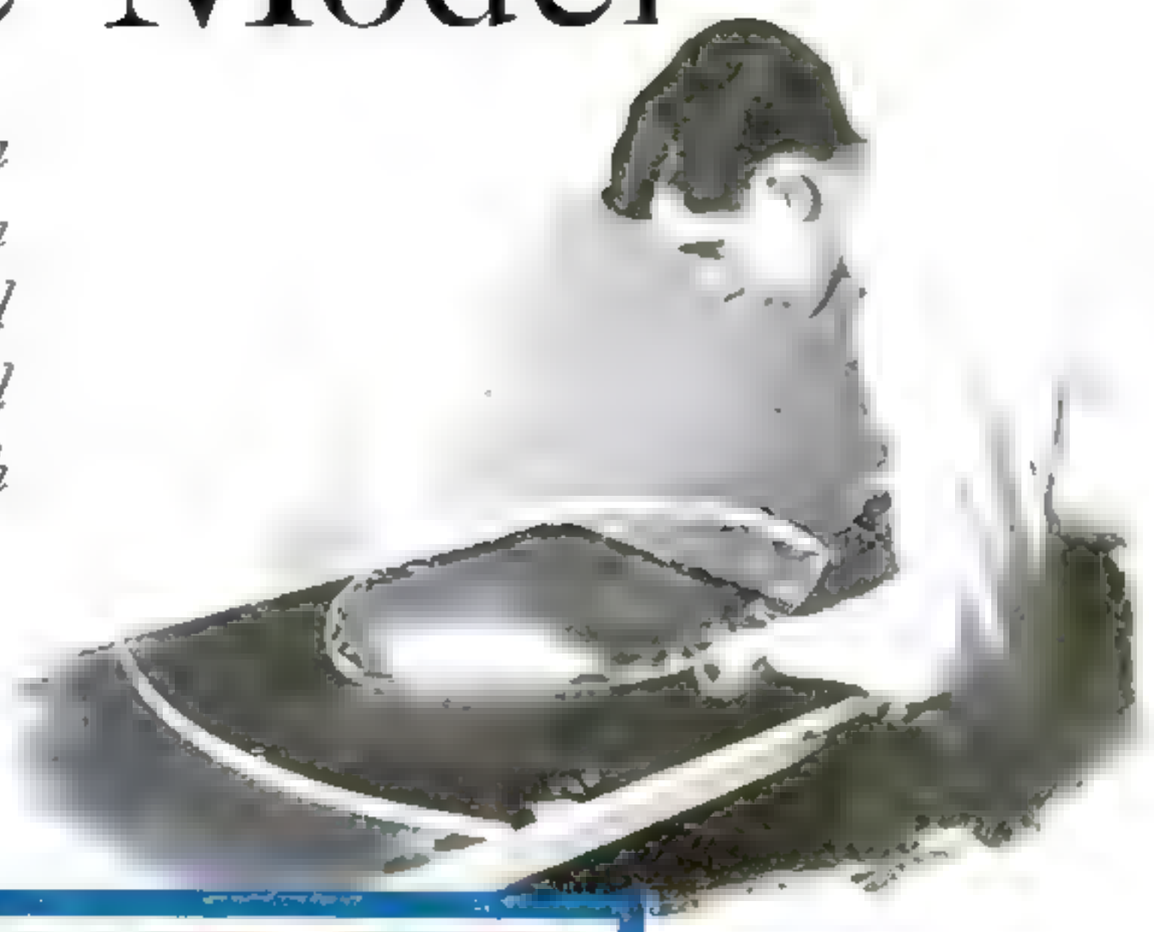
Details for a class-B indoor tractor model made by Carl Schmaedig, of New York. It embodies the constructional features described in the text

Indoor Plane Model

How to make featherweight balsa tubing . . . propellers so thin you can read print through them . . . matched wing spars . . . and microfilm measured in hundred-thousandths of an inch

By FRANK ZAIC

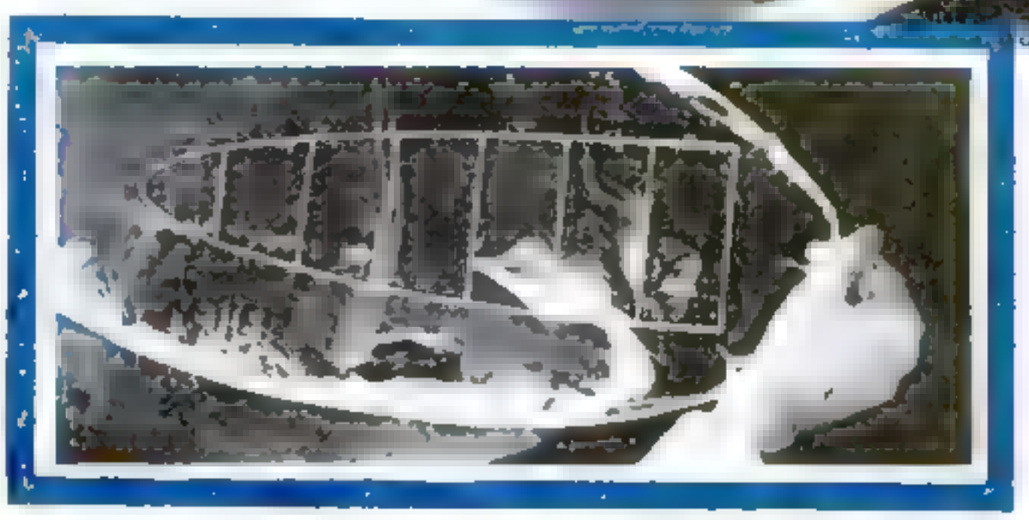
Editor of *Model Aeronautics Year Book*



Lifting microfilm from the surface of a tank of water with a wire hoop. *At left:* Covering a wing with the unbelievably thin cellulose

therefore very even. All that is needed is a hardwood form of slightly smaller size than the finished article, around which the moistened and outlined balsa sheet is shaped and held in place with cotton gauze. To hasten evaporation, the form is placed in a preheated oven for about ten minutes, but be sure that the gas is turned off or very low. Remove the balsa from the form and cement the seam.

Sheets cut on line *C-C* in the log diagram have laminations of several years' growth and are comparatively stiff. They are especially suitable for making cut ribs. Such ribs are stiff and keep shape, where-



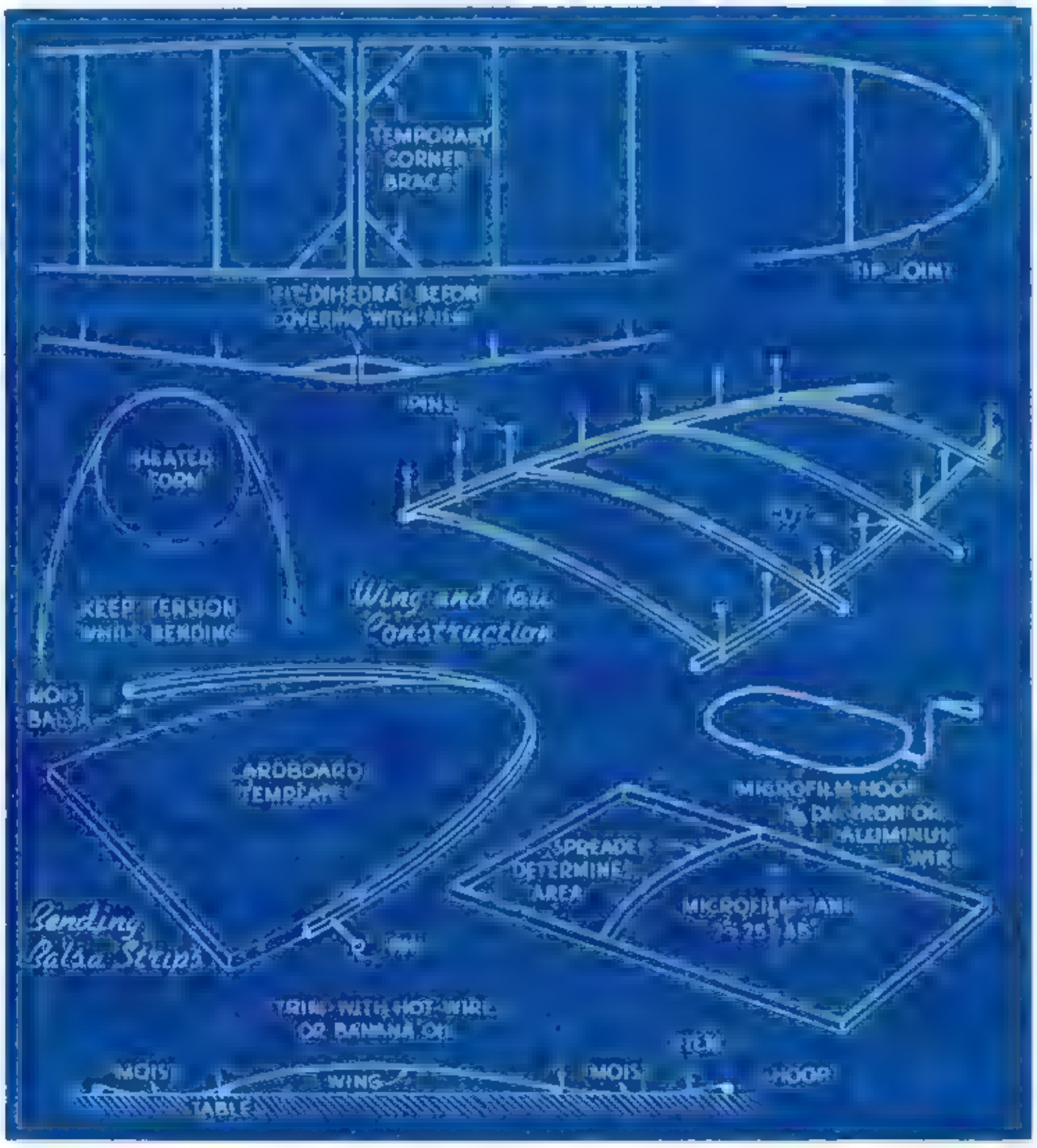
as bent ribs slowly lose their shape.

The cut marked *B-B* is all-around stock. It can be used for spars, tips, and other items.

The simplest method of making tapered spars is to taper an entire sheet by sandpapering. Gradually edge towards one end after every stroke, and also regulate the pressure on the sandpaper block—light on the high side and hard on the tapered portion. Use medium sandpaper followed by 10, 0 for finishing The spars are cut from the tapered sheet by measuring the width on each end and connecting the points. While cutting, press hard against the steel ruler to make sure that the wood does not creep. Match the spars both by weighing and by holding the thick portion on table and suspending a weight from the tip as shown. Equal weight and bend mean matched spars.

The wing and tail surfaces are assembled on a full-sized plan drawn with the outside dimensions only. Pins are pushed in the baseboard at the points where spars and ribs meet to hold the spars to outline. Hold the spars against the pins with other pins, and also set them at the required angle to conform to the rib flow. The ribs are cemented to the leading edge first After the cement has set, they are fitted and cemented to the rear spar. If the wing has an elliptical or other curved form, moisten the spars so that they will keep shape when removed from jig.

In the early days it was difficult to make curved balsa tips, and 0.01-in. round bamboo was used. The weight saved by using balsa curves will, however, add a few more seconds to the record time. The wood strip must be of straight grain and cut. Soak it in water until saturated and bend it over a hot form while under steady tension. For circular shapes, an electric soldering iron, hot pipes, and electric bulbs *(Continued on page 120)*



How the wings are made in two sections; methods of bending the tips; and a microfilm tank and hoop

Six New FURNITURE

DRESSING TABLE WITH STOOL AND MIRROR

Here's a royal gift for milady, all three pieces designed in Queen Anne style

NO PIECE of furniture is likely to please a woman quite so much as a beautiful dressing table. It should be dainty and graceful, its lines should bespeak refinement, and its beauty should impress everyone who sees it. The Queen Anne style is particularly appropriate and therefore was chosen for the table, stool, and mirror of this group. All three pieces have been designed to go together, and as a definite indication of this, the shape of the table apron has been repeated in the top of the mirror frame. The legs and carving on the stool are also similar to those on the table.

To build the dressing table (Figs. 1 to 8), first make the legs. Walnut should be used to be correct, though maple may be substituted. The legs are of solid stock, 3 by 3 by 29⅛ in. The small blocks at the tops of the cabriole are glued to the leg before it is sawed to shape. Prepare a pattern of cardboard by laying out 1-in. graph squares as shown in Fig. 3. Trace this on one side of the leg and saw to shape, saving the waste. Tack the waste back on the leg, mark the design on the adjacent side of the stock, and finish the sawing.

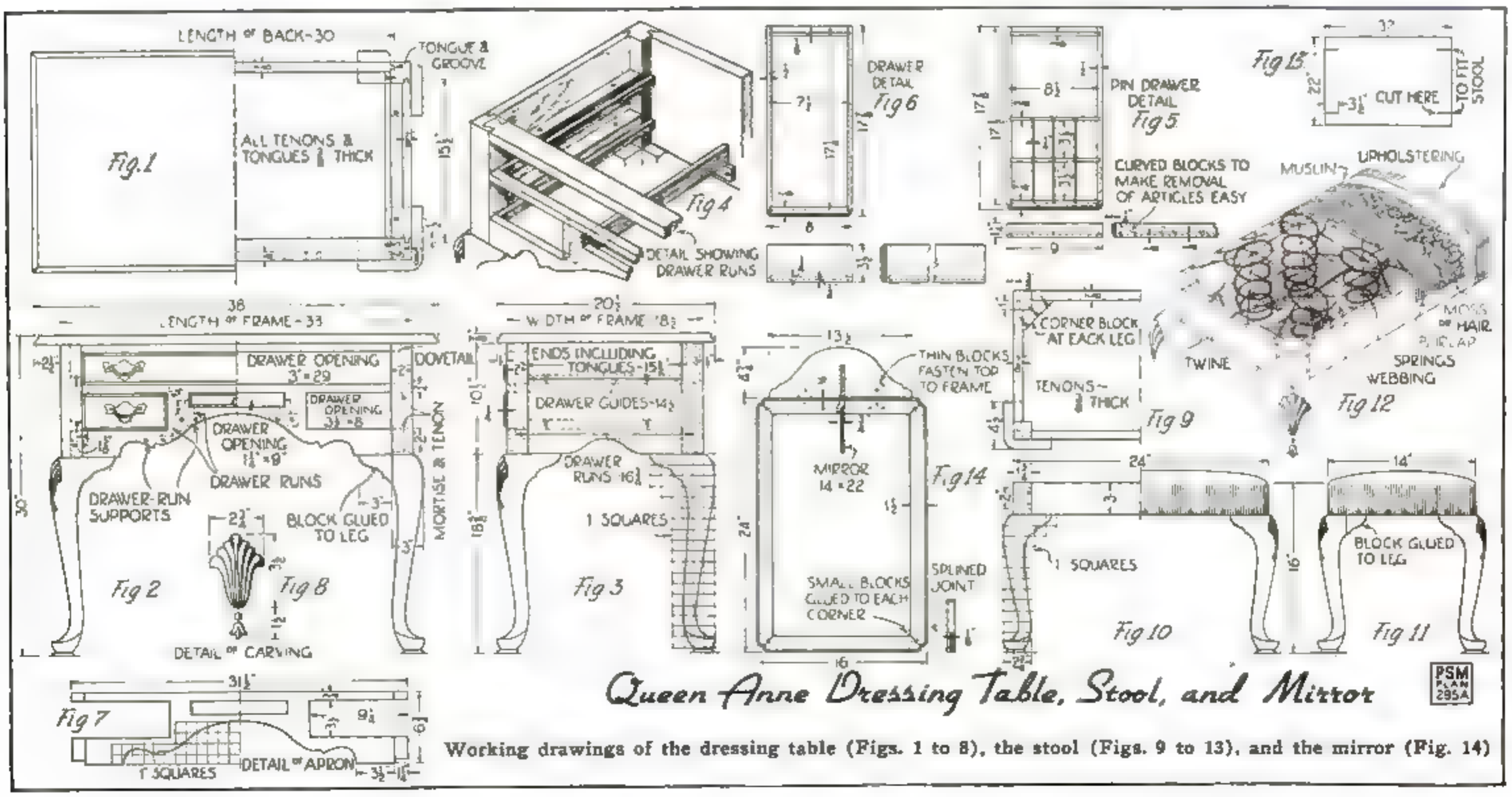
The legs should now be dressed and squared at the top to 2 in. square. To form the lower part of the leg, first shape it roughly to an octagon section. This will be a true octagon only at the ankle of the leg, where the leg will later become round. The sides of the octagon at all other places will not be exactly alike because the leg is not to be made perfectly round, though each corner will be rounded considerably. Hold the leg up in front of you occasionally as the shaping progresses and compare one leg with another so as to get all of them alike.

Next mortise and groove the legs. Most of this work may be done on machines if a mortising outfit is available, otherwise it must be done by hand.

Dress the ends and the back. Cut the tongues and fit these members to the legs. Lay out a pattern for the front apron, as shown in Fig. 7, and make this piece. Fit the joints carefully so as not to split this piece; in fact, it is a good idea to fit the joints before cutting the drawer openings. When this has been done and the drawer openings cut, the frame may be assembled.

Get out a piece for the upper stretcher, which is dovetailed to the tops of the front legs. This may then be fitted and glued in place, thus completing the frame.

Now make and fasten the drawer *(Continued on page 107)*



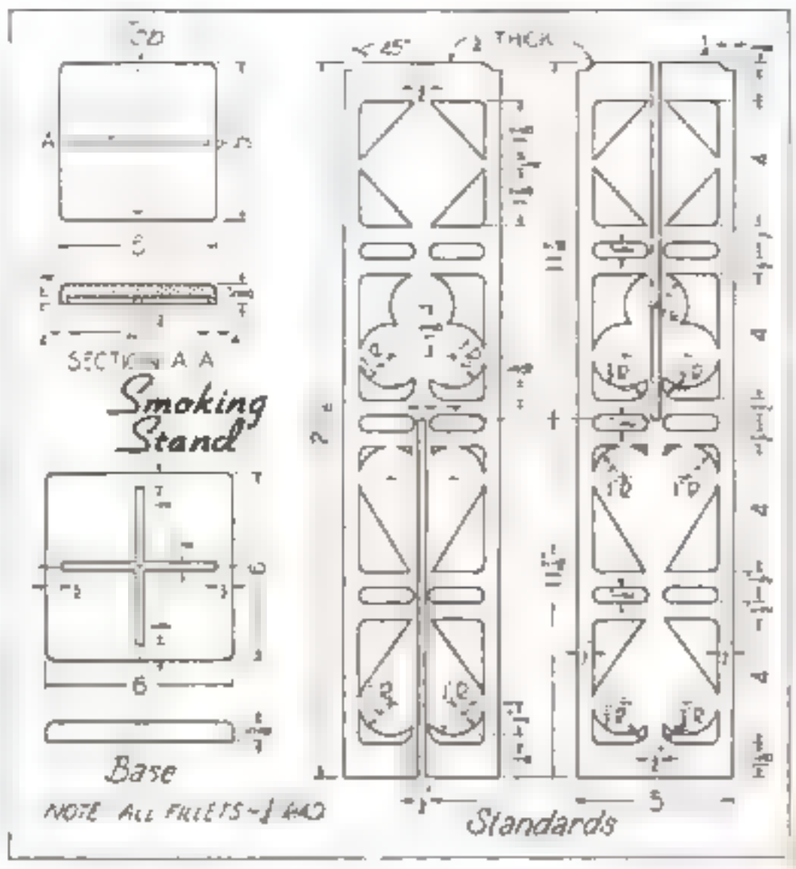
Working drawings of the dressing table (Figs. 1 to 8), the stool (Figs. 9 to 13), and the mirror (Fig. 14)

PLANS *for Home Woodworkers*

SMOKING STAND JIG-SAWED FROM AN ORANGE CRATE

FIVE or ten cents will buy the wood for this jig-sawed smoking stand, because it may be made from one empty orange box or crate. Select a box that has at least two straight side or bottom pieces, free from knots and cracks, and fully ¼ in. thick; and see that the end pieces are solid wood, not built up.

Tack together two long boards from the box, plane the edges, and square the ends. Now lay out the design and mark the long slot. At the end of the slot drill a ¼-in. hole to avoid splitting, especially if the slot is to be cut with a knife and straightedge. Separate the pieces and refasten them so that one slot runs from the top down and the other from the bottom up. Drill ½-in. holes in each corner of the four panels and at the ends of the six openings between the crossbars. You can then cut the design.



The top and base are cut from the ends of the orange box. The slots in the top are only 4½ in. long by ¼ in. deep, the top of the standards being trimmed to fit. In the base the slots are 5 in. long and go all the way through.

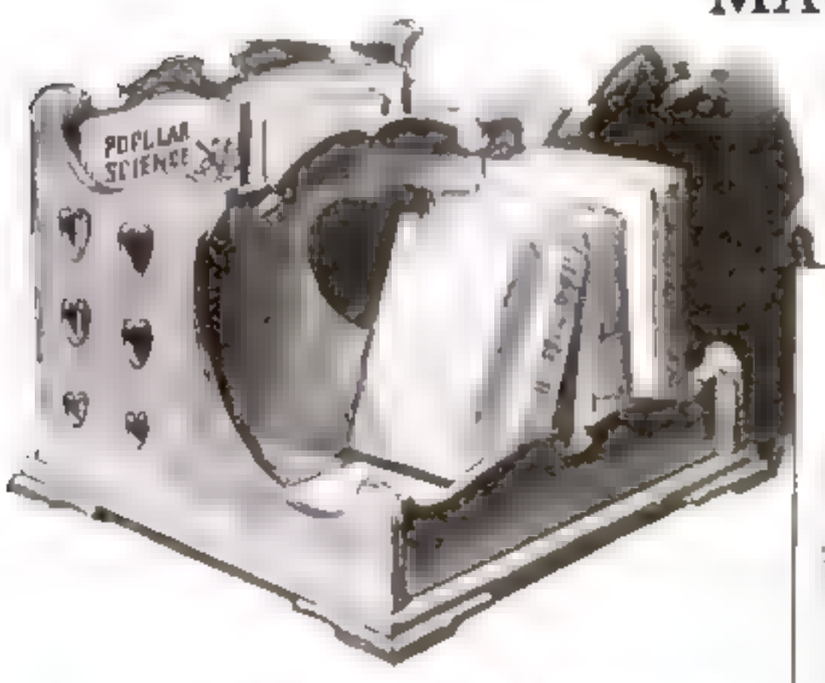
Sand the assembled piece thoroughly. The original stand was given three coats—a primer, a semigloss, and a finishing enamel. The diamond, heart, and opposite edges of the standard were painted red; the club, spade, and other edges of the standard, black; the crossbars, upper and under surfaces of top, and upper side of base, white; the edges of top and base, alternately red and black.—CHARLES I. HEALY.

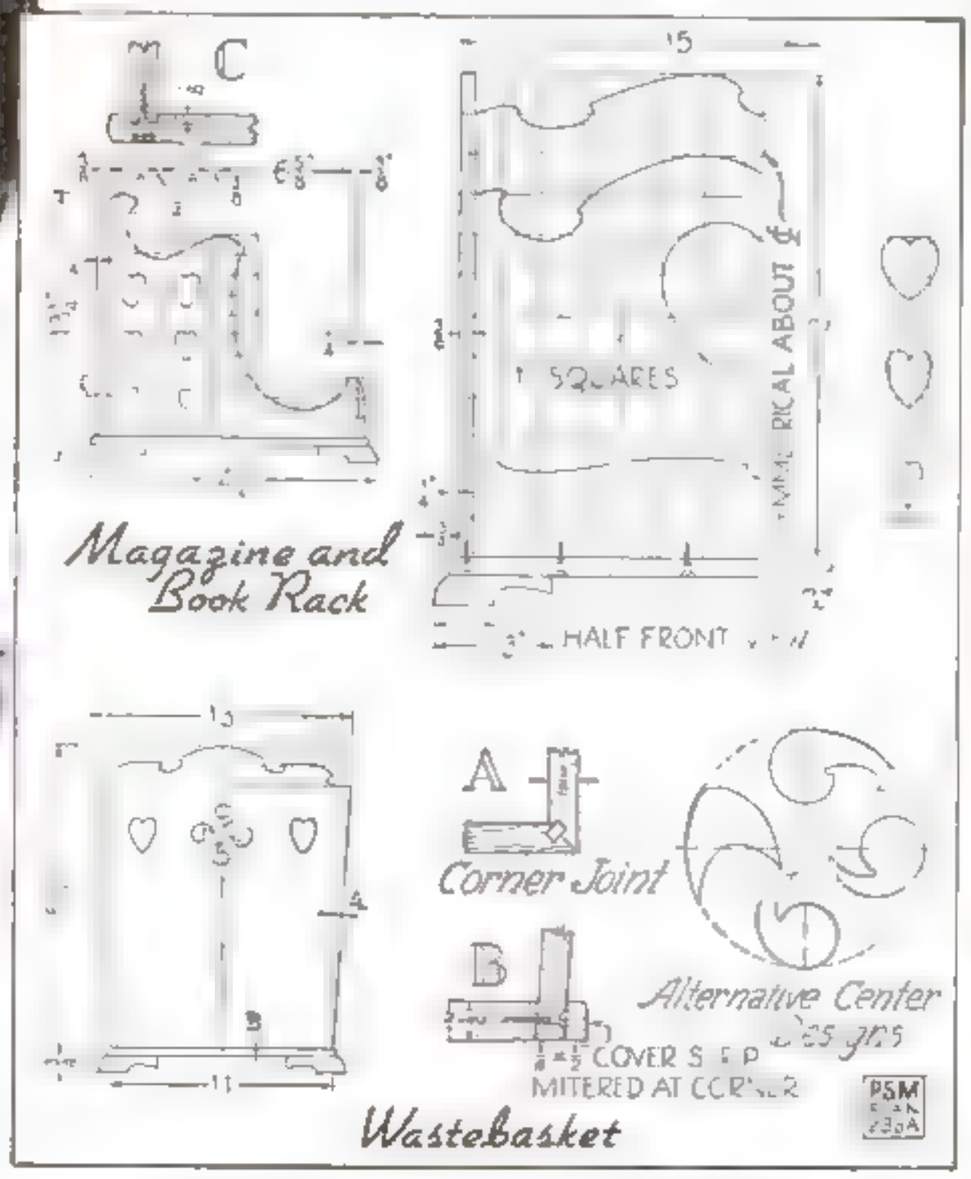
Only four parts, made as shown at left, are used, and the two standards are cut out in one operation

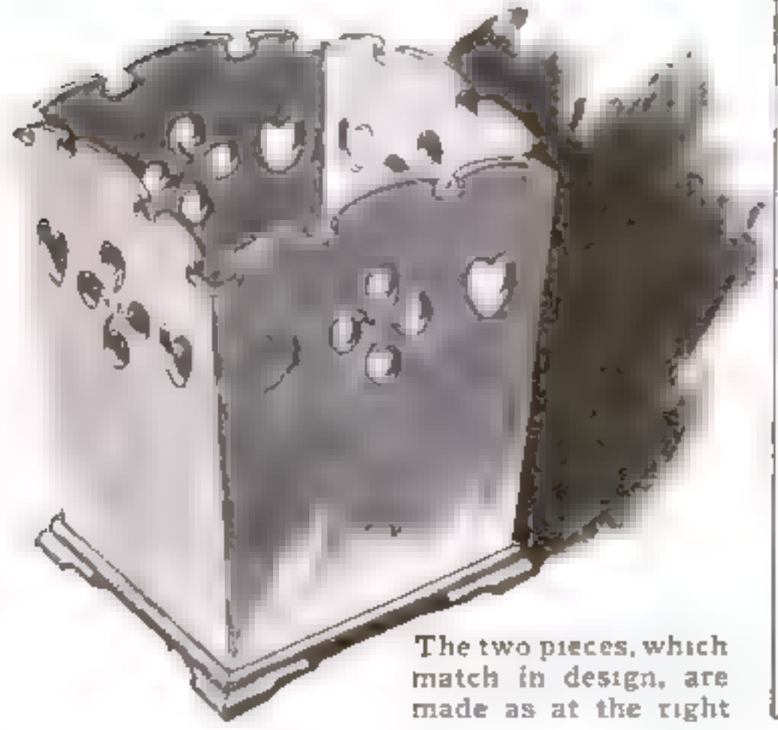
When well sanded and finished with enamel, the stand does not betray its humble origin

MAGAZINE RACK AND WASTE-PAPER BASKET

DESIGNED as companion pieces this magazine rack and waste-paper basket harmonize with each other. They may be made of solid wood throughout, in which case it will probably be necessary to glue up the stock to obtain the necessary widths. If available, however, plywood having a good face veneer of birch on both sides and with a hardwood core is recommended. It may be stained to match any desired finish and is considerably less expensive than walnut or mahogany.







The two pieces, which match in design, are made as at the right

Only the essential dimensions are given on the drawings, but reference to the list of materials at the end of the article, which gives the overall sizes, will assist you in getting out the stock.

The partitions of the rack should be grooved into the sides as shown in detail *C* and fastened with hidden screws. This assembly may then be placed on the base and scribed around with a pencil to insure the proper location of the holes through which it is secured to the base with small screws from the underside. The feet are formed by band-sawing 3-in. square blocks from two sides to the outline shown and then rounding off the two exposed edges to a curve having

(Continued on page 108)

Washing calcimine from a ceiling with the new type of nondripping cellulose sponge and trisodium-phosphate cleaning powder instead of soap

One recently developed and unusually efficient cleaner is mixed with cold water to form a thin paste and applied with an old, wide paintbrush

To avoid dust and insure speedier and cleaner work the sanding is done wet whenever possible with waterproof sandpaper, in this case No. 0

First Steps in INSIDE PAINTING

. . . WASH THE WALLS FROM THE BOTTOM UP

By Ralph G. Waring

ANSWERING the phone in my laboratories the other day, I recognized the voice of an old acquaintance. He sounded a bit disturbed.

"Why, what's the matter, Jack?" I asked.

"You gave me some advice a few weeks ago about enameling my kitchen, dining room, and living room."

"Yes, I remember."

"Well, I bought what you told me to, and the paint simply wasn't any good. I put it on two weeks ago and most of it isn't dry yet. And I did exactly what you said, too."

"You're quite sure of that, are you?" I returned. "Then why didn't you wash the walls and woodwork with the washing powder I specified?"

He seemed quite taken aback. "Why, how—I mean, what makes you think that?" he stammered. "Have you been down to the house to look at the job?"

"No, but I can tell without seeing it that your kitchen enamel is just about as sticky now as at first. Your dining-room job is a little better, but not much. The living room no doubt looks pretty good and has dried properly. How about it?"

"Man, you must have X-ray eyes to tell me that much over the phone. To tell the truth, Mr. Waring, I didn't wash the walls. I thought you were being a bit technical. It looked like an awful job, and I thought the enamel would cover it."

"Well, if it looked that bad, all the more reason why it should have been washed with a trisodium-phosphate washing powder in the first place. Now you really do have a job of washing on your hands. Mix two parts of turpentine substitute and one part of pure turpentine and use it to wet the sticky enamel. Let it soak about five minutes, then take number two steel wool to loosen it from the walls and trim. Next, wipe down with old rags, and finally wash clean with fresh turpentine. You had better use a good grade of rubbing brush to help you on any molded parts of the trim. Let dry about a week and then re-enamel over one coat of undercoater. You wouldn't have had to buy any undercoater if you had washed the trim and walls properly in the first place. By the way, Jack, be sure not to smoke during this job, and see that you and your wife 'eat out' the day you wash the kitchen. You don't want to burn up the house. Of course, I know that you are 'burnt up' anyway, as the kids would say, but I don't see any other way out of it."

What had happened in this case was that the film of cooking smoke and grease on the kitchen surfaces, while barely discernible, had still been sufficient to combine with the enamel and stop the drying process entirely. The dining room naturally had less of the film, but enough to slow up the drying from four hours to about three weeks. There was nothing the matter with the enamel.

All this brings us to the important subject of washing materials, equipment, and methods.

One of the most practical washing materials in recent use consists of a slightly yellowish flour or meal, similar to wallpaper paste flour. When mixed with cold water to form a thin paste that will not quite drip from the brush, it is one of the fastest working cleansers. It is easy to wash off, takes all the dirt with it, does not affect the gloss except for an hour or two, and does not injure hands, brush bristles, or paint or varnish films in any way. In addition, it has no odor and does not leave any film on a properly rinsed surface.

The last-mentioned condition must be considered, for while some soaps do a good cleaning job, they leave an insoluble soap film on the work, especially in regions with so-called "hard" water. This film has frequently proved to be a real trouble maker after the new coatings have been applied, and peeling and flaking have started in a year or less. It happens most often when ordinary laundry soap is used to wash plaster walls. The insoluble film left behind is almost a guarantee that the paint will peel later. *(Continued on page 105)*

HOW TO WIND A

Step-Down Transformer

FOR ELECTROPLATING AND OTHER PURPOSES

By Kendall Ford

ONE excellent way to adapt ordinary 110-volt alternating current for electroplating, which requires low-voltage direct current, is to use a homemade step-down transformer in conjunction with a rectifier, as explained last month (P. S. M., Nov. '36, p. 62).

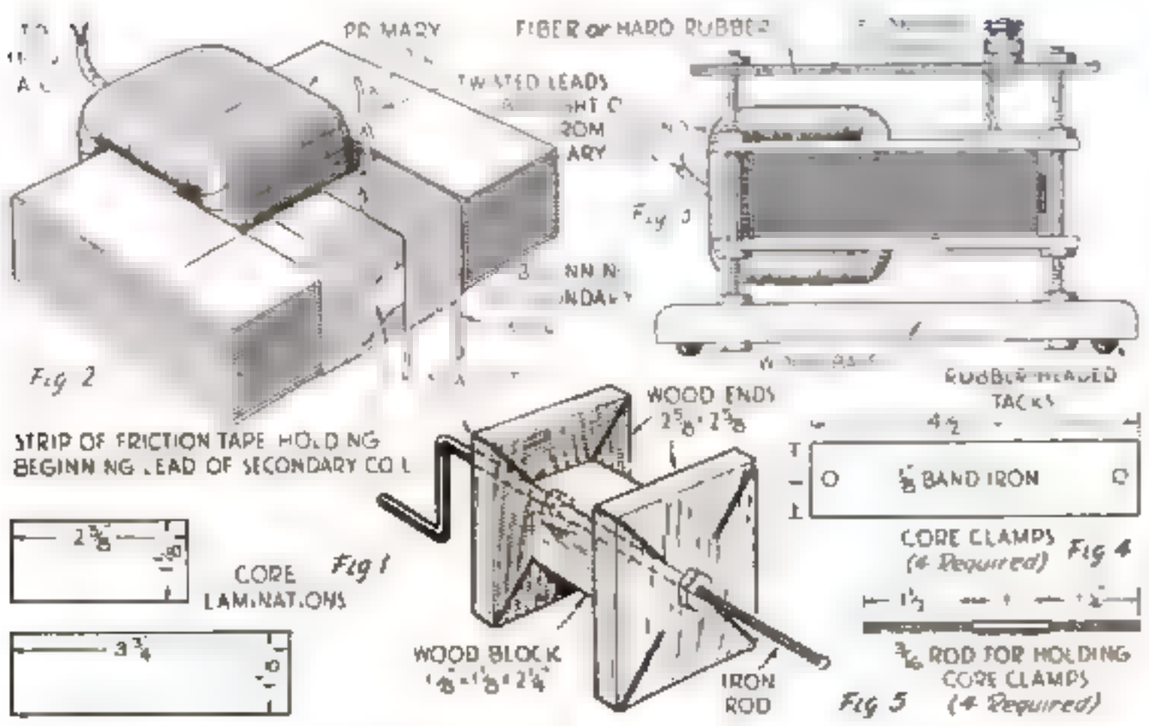
The transformer shown in the accompanying illustrations was especially designed to operate in conjunction with an electrolytic rectifier in a circuit such as that marked Fig. 4 in the previous article, but with slight changes it may be used with a discarded radio battery charging rectifier. It is also a good general utility transformer for ordinary purposes because it has a range of from 2 to 20 volts in 2-volt steps.

For use with an electrolytic rectifier, a transformer should have two secondary windings, each delivering 6, 8, and 10 volts. This makes it possible to adjust the voltage over an extremely wide range with a single rheostat.

The first operation in building the transformer is to cut a sufficient number of transformer laminations to make a stack of each size 2¼ in. high when pressed tightly together. Suitable laminations can usually be obtained from burnt-out transformers, but if these are not obtainable, No. 26 gauge stove pipe iron may be substituted. Drive a number of nails into a board to make a form for stacking the transformer core, and place a strip of tape across each end to hold the laminations temporarily in place, as illustrated in a photograph. The nail form should be 4⅞ in. long. Begin stacking the core sections by placing one of the longer laminations against one end of the form, and another long lamination against the opposite end of the form. Continue to stack the long core laminations alternately until half of the total number is used.

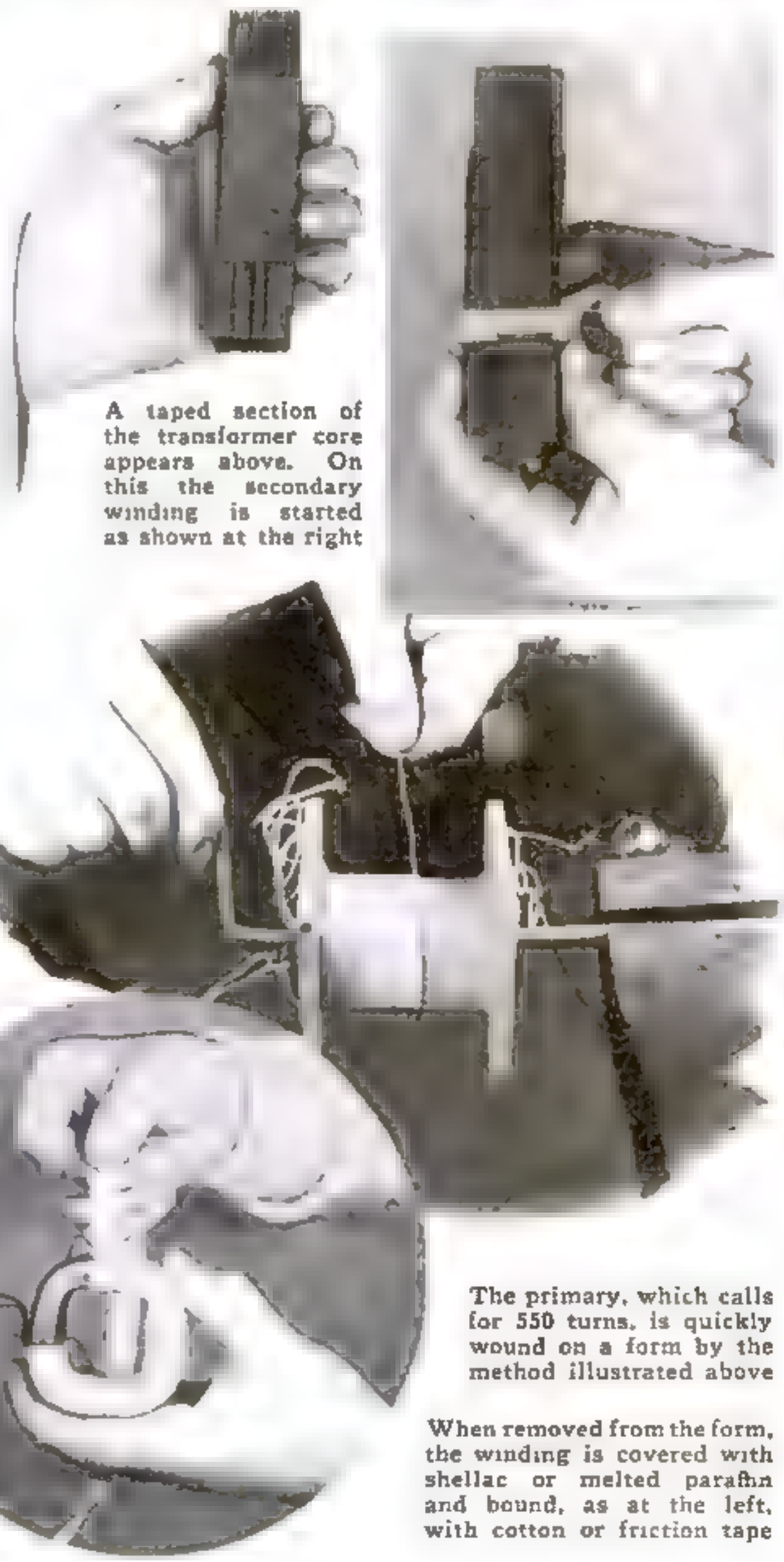
Secure the two strips of tape around the assembled core section and carefully remove it from the stacking form. Place the core section in a vise with about 1 in. of the solid portion of the core extending beyond the vise and wrap this solid portion tightly with friction tape. Continue to move outward from the vise and tape about ¾ in. at a time until the whole solid portion of the core section is taped. Wrap a second layer of tape around the core section and coat with shellac. Proceed with the remaining long laminations as above, making two taped sections in all.

(Continued on page 92)



Core laminations, winding form for the primary coil, a sketch showing how secondary leads are brought out, and method of mounting the whole

The method of stacking the laminations is shown in the oval. They are bound with tape before being removed from the form



A taped section of the transformer core appears above. On this the secondary winding is started as shown at the right

The primary, which calls for 550 turns, is quickly wound on a form by the method illustrated above

When removed from the form, the winding is covered with shellac or melted paraffin and bound, as at the left, with cotton or friction tape

GIFT CRAFTWORK to Keep

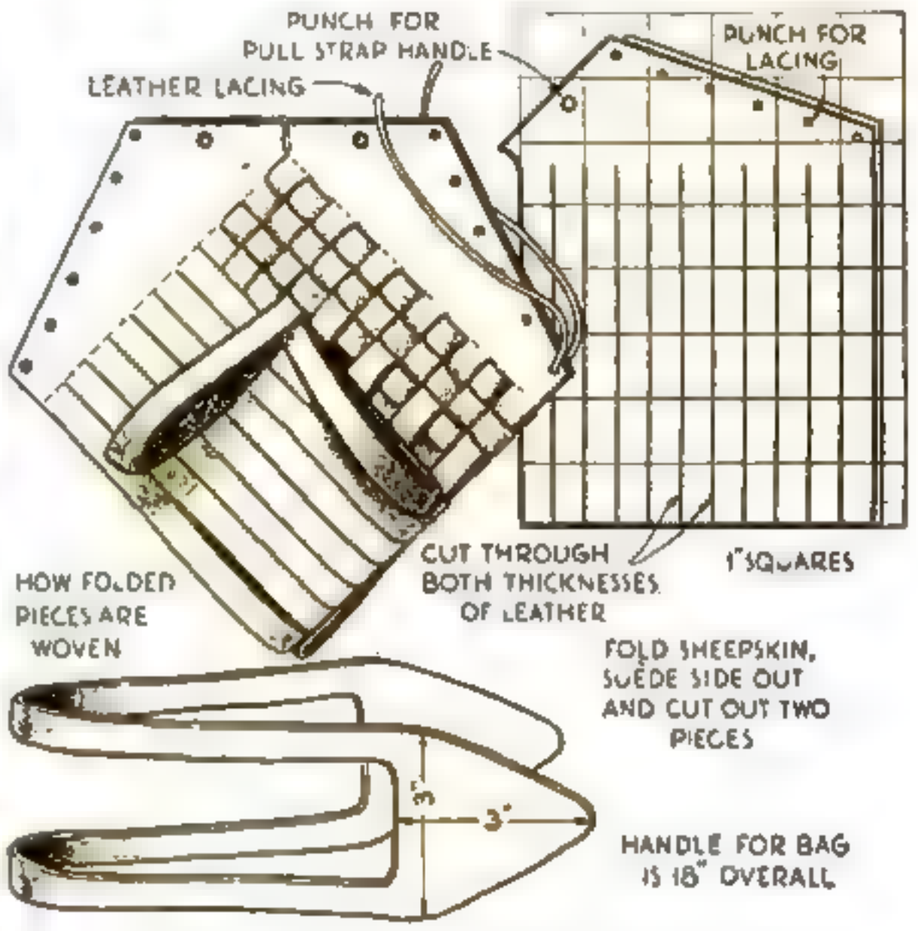
Although it appears to be skillfully woven from a number of strips, the bag is really made of two large pieces, cut as in the drawings and intermeshed

HOW to weave a hand bag of the type shown in the accompanying illustrations is a trick taught me by an old Indian. Two pieces of sheepskin of any desired color are required, each 6 by 16 in.; also a piece of the same leather 3 by 18 in., and two strips 3/16 by 12 in. for lacing.

Fold the two large pieces, suède side out, and cut as shown in the drawing that gives the pattern. Then, with a pair of sheers, cut the double thickness evenly into ½-in. strips. This done, lay one piece across the other, with the strips of one crossing the strips of the other, and begin weaving.

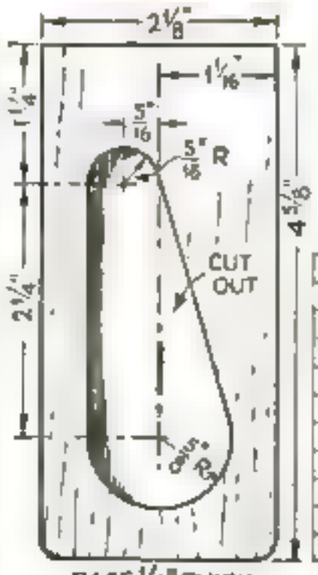
Put the end of the first loop on one side through the first loop on the other side, then alternate, and continue until the bag is all woven. This is much easier to do than explain, but a study of the illustrations should make the process clear, especially after you actually have the two pieces in your hands. When the weaving is finished, lace up the sides and tie the laces on the inside so that the knots will not show.

The bag should be lined with a suitable cloth lining, and if desired a 5-in. slide fastener may be added; however, to carry out the Indian idea, the sheepskin strap is more appropriate.—D. HUTCHINSON.

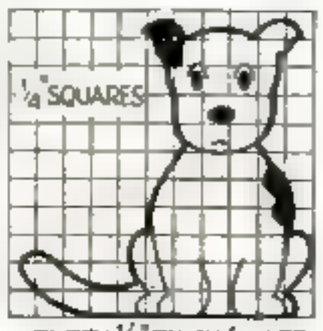


NOVEL PUPPY PIPE REST SAWED FROM SCRAPS

MATERIALS for this colorful little pipe rest, with its faithful puppy guarding your favorite brier, can be found in almost any scrap box. First, enlarge the pattern for the dog to the proper size, transfer the design to a piece of ¼-in. thick wood, and jig-saw it to shape. Then lay out the base and cut it from ½-in. material. Sand the two pieces thoroughly and fasten the puppy in place with glue and brads. Apply a coat of flat paint or prepared enamel undercoat to the entire novelty, then follow either the color scheme shown or the one noted on the drawing. If you prefer, you can use other colors. Two coats of each are desirable to give a smooth, brilliant finish. Sandpaper the first coat of enamel lightly.—CARL SORENSEN.



The pipe is set in an opening cut right through the baseboard at an angle so the stem will rest on the tail of the dog

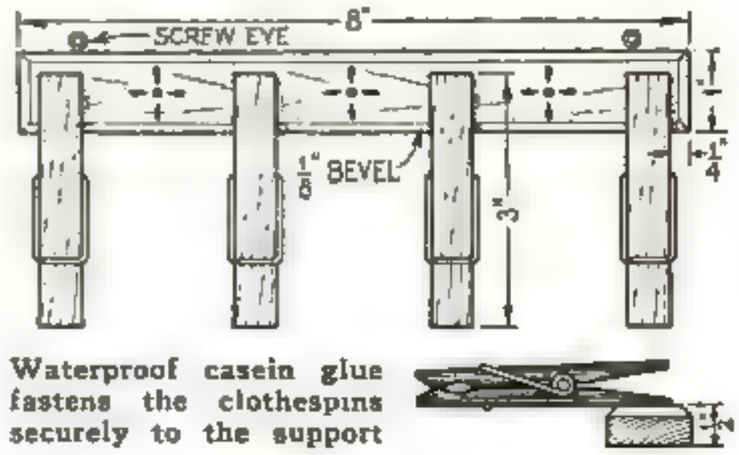


DRIER FOR SILK STOCKINGS

A DRIER for silk stockings of the type shown at the right is a useful gift that is very easy to make, yet certain to please any woman. It provides a better method of drying stockings than draping them over a radiator.

Take a scrap piece of ½-in. board and finish it to approximately the size indicated in the drawing. Do not make it any shorter than 8 in. or the stockings will be too crowded to dry quickly. Glue on four spring clothespins as shown, using waterproof casein glue. Be sure the pins are evenly spaced and are on straight. After the glue is dry, apply a good grade of spar varnish. If a fancy touch is desired, a design may be painted on with oil paints or enamels before varnishing, or even ordinary water color may be used and the varnish quickly flowed over the painted parts after they are dry. Two small screw eyes are inserted in the top so the dryer may be suspended.—HARRY N. BECKER.

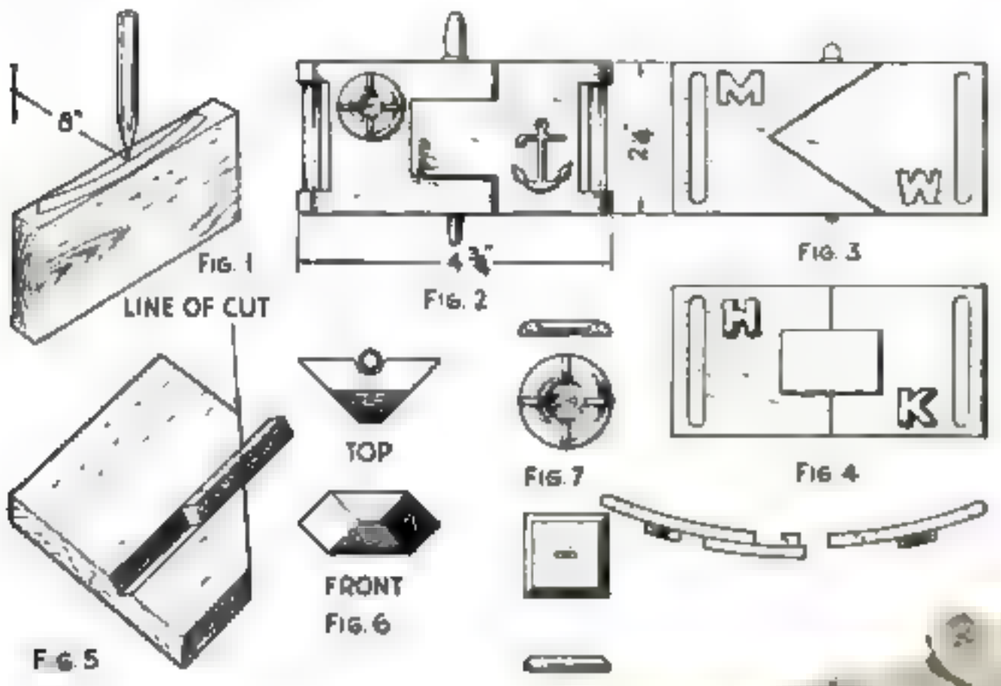
Stocking drier made from four spring clothespins and a piece of ½-in. thick wood



Waterproof casein glue fastens the clothespins securely to the support

Your Home Workshop Humming

HARDWOOD BUCKLES AND BUTTONS



ACCESSORIES FOR SPORTS WEAR

A variety of attractive wooden buckles, buttons, and ornaments may be cut from hardwood as shown in the drawings at the left. These fine-looking accessories are particularly appropriate when used with home-knitted sports wear

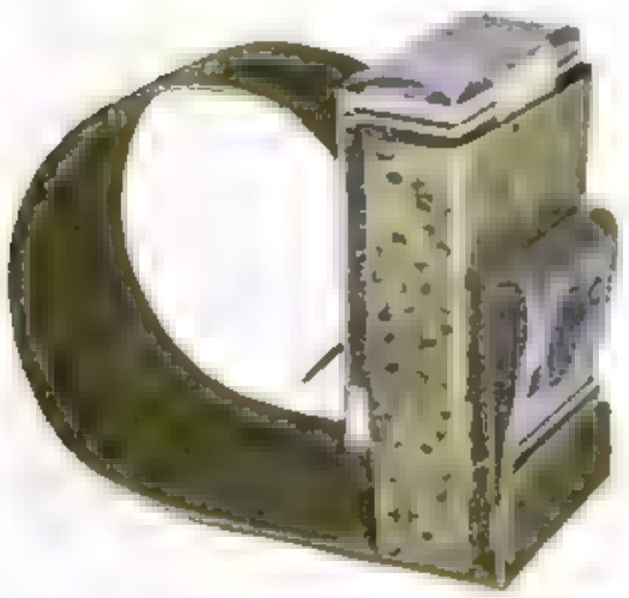
WITH the current fad for home-knitted sports wear in full swing, it behooves the home workshop enthusiast to adorn milady's costume with such essential accessories as buckles and buttons. Various woods and designs may be used, and a few that have met with popular approval are illustrated. Gumwood was found satisfactory by the author because of its toughness and workability. A piece ¾ by 2¼ in. by 3 ft. is ample for several buckles, and the left-over scraps may be made into buttons, pins, and ornaments.

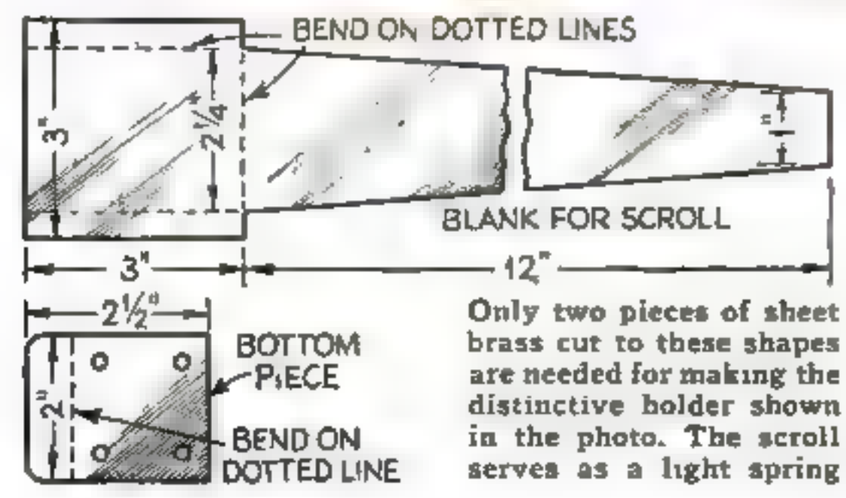
For a buckle, two segments of circles are drawn about 5/16 in. apart on the edge of the wood from a center 8 in. away (Fig. 1). On a band or jig saw, cut out the section and square off the ends to about 4¾ in. long. The sanding may be done by hand or on disk and drum sanders. Next, decide on the design, preferably after consulting the girl friend. If the hinge-and-pin type buckle is decided upon, drill the vertical holes for the pins and belt-fastening dowels before any cuts are made. Make all cuts with a jig or coping saw, and use a very thin fret or puzzle blade. Round off the ends (Fig. 2) so that the hinge will swing freely in its position.

The hinge pin may be turned on a lathe from wood, or metal pins from small cabinet hinges may be used. The pin should be a fairly loose fit. In Fig. 2 a miniature belaying pin is used for the hinge. A small piece of watch chain may be added between pin and anchor; it improves the appearance and prevents the loss of the pin.

The buckle in Fig. 4 has a hasp-and-hook fastener, which allows a slightly thinner buckle than is possible when using a pin. The detail drawing shows how the hasp and *(Continued on page 109)*

SCROLL-TYPE BRASS CIGARETTE HOLDER





Only two pieces of sheet brass cut to these shapes are needed for making the distinctive holder shown in the photo. The scroll serves as a light spring

DESIGNED like a modern scroll-type book end, this decorative holder for a pack of cigarettes and a book of matches is made from two pieces of fairly heavy sheet brass cut to the shapes shown in the diagrams.

After the blanks have been prepared, lay each piece on an anvil or other metal surface and use a ball-peen hammer to mark the outside with more or less uniform indentations. Then hold the tapering end of the larger piece over a length of iron pipe gripped in a vise and hammer it into the desired scroll shape. Bend the large end along the dotted lines in the drawing to form a pocket for a package of cigarettes. Adjust the tension of the scroll part so that it presses firmly against the package without squeezing it.

After bending the smaller piece, drill four holes in it and solder it in place as shown in one of the photographs. The holes simplify the job of soldering and hold the two parts together as if they were riveted. File off any excess solder, then clean the holder with steel wool or by scratch brushing, and finish with a thin, clear lacquer.

Soldering is made easier by the four holes

Short Cuts for Car Owners

Our Readers Pass Along Six Kinks That Have Helped Them to Keep Their Automobiles in Condition

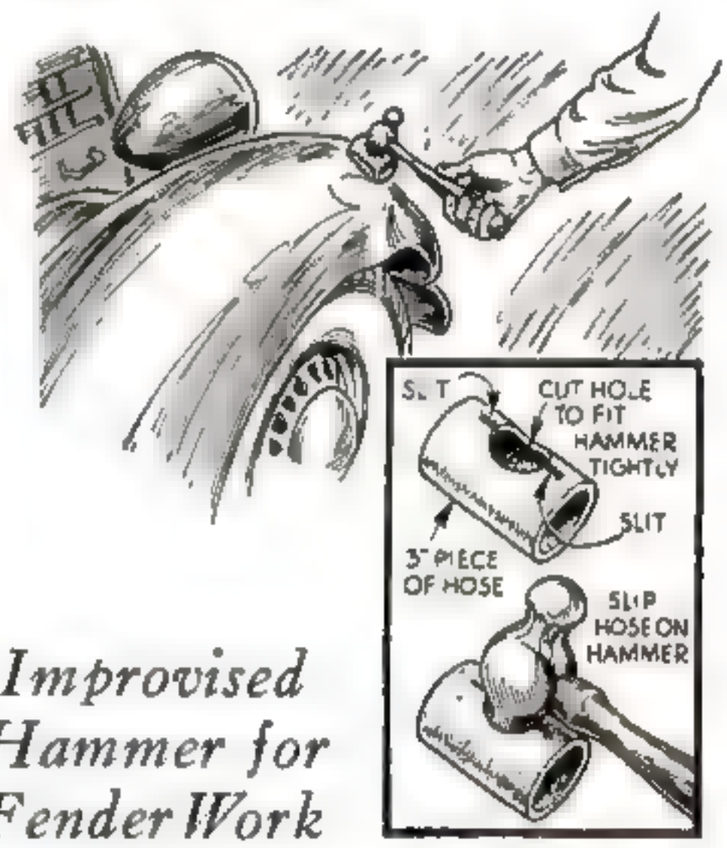
Portable Car-Washing Kit Made from Large Oil Can

FROM an ordinary five-gallon oil can, you can make a handy car-washing pail. Altered with a pair of tin snips, as shown at the right, it not only supplies a large container for water, but a convenient shelf, at just the right height, for brushes, chamois, cloths, and polishing equipment. The strong handle on the top of the can allows it to be moved from place to place easily. If desired, several coats of enamel can be applied to the outside of the can.—W. H.

Repairing a Cracked Distributor Cap

After scraping the crack, the cap is coated with oil

WHEN a cracked distributor cap causes a short circuit and stops your car on the road, an emergency repair can be made with oil and a knife or a screw driver. After scraping the crack clean, hold the cap upside down and squirt in enough oil to cover the inside with a thin film. Then turn the cap right side up and drain off the excess. When replaced, the cap will hold up for quite a few miles.—R. R. K.

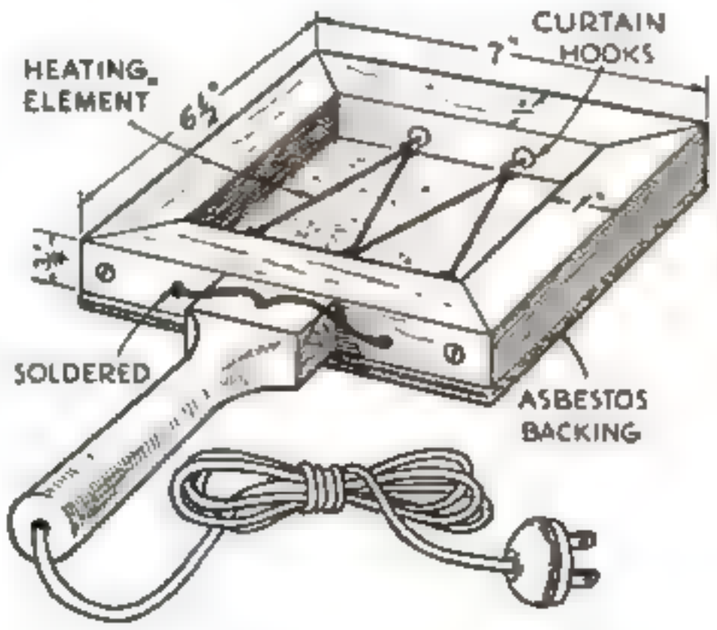


Improvised Hammer for Fender Work

A SOFT-FACED hammer for use in making fender and body repairs can be improvised easily by supplying an ordinary hammer with a rubber head cover made from a short length of garden hose. Simply cut a hole in the hose, supply two slits each side of the hole, as shown, and stretch it over the hammerhead. The elasticity of the hose will hold the cover in place.—H. A.

Heater for Lacquer Jobs

TO MAKE it possible to touch up the finish on my car during the winter when my unheated garage is so cold that lacquer will not flow freely, I devised a simple surface heater. Consisting of an asbestos-backed frame supporting several feet of heating-element wire, the heater, held against the underside of the spot to be finished, warms the metal just enough to make the cold lacquer flow so that it can be brushed on the surface easily and evenly.—M. G.



Castor Oil Sleetproofs Car's Windshield

CASTOR oil applied with a handy homemade applicator will keep your windshield clear of frost and sleet during winter storms. The applicator is made by forcing a tight roll of flannel or felt into a small screw-cap can or jar, as illustrated, and saturating it with the oil. The screw cap will protect the top of the cloth and prevent the oil from leaking out when the application is stored.—A. H. W.

Wax Silences Door Hinges

SQUEAKING car-door hinges that do not react to ordinary oil can generally be silenced effectively by lubricating the pins with liquid paraffin. The writer solved the problem of applying the paraffin in liquid form by partially filling an old squirt can with the melted wax and allowing it to cool. When it is to be used, the can is simply heated on a gas stove.—W.C.W.

DEEP INTO THE WOODS. No luxuries here, as "Herb" Welch — famous Maine Guide—makes noon camp. Hearty outdoor appetites welcome the sense of digestive well-being that smoking Camels encourages. As "Herb" says: "I've lived on dried meat and I've dined on the best—but no matter what I'm eating, it always tastes better and digests better when I smoke Camels."

WHEREVER...
WHATEVER...
WHENEVER
YOU EAT—

For Digestion's Sake... Smoke Camels!

Costlier Tobaccos

Camels are made from finer, MORE EXPENSIVE TOBACCOS ...Turkish and Domestic... than any other popular brand.

Smoking Camels encourages a proper flow of digestive fluids...increases alkalinity...brings a sense of well-being

YOU eat over a thousand meals a year! Food is varied. Place and time often differ. Yet, thanks to Camels, you can help digestion meet these changing conditions easily. Smoking Camels speeds up the flow of digestive fluids. Tension eases. Alkalinity increases. You enjoy your food—and have a feeling of ease and contentment after eating. Mealtime or *any* time—make it Camels—for digestion's sake, for Camel's invigorating "lift," for mildness and fine flavor. Camels do not get on your nerves.

ROUTES 100 TRAINS A DAY. H. M. Wright, train director, says: "I smoke Camels and I can count on good digestion."

GLIDER CHAMPION. Mrs. D. Holderman says: "A few Camels, and I eat with relish and feel cheery and at ease afterward."

PLANNING...LIGHTING...TAKING

Your Christmas Movies

By
FREDERICK D. RYDER, JR.

Filming an animated title for a Christmas movie. A toy tractor draws the letters across a moonlit winter landscape, and on the screen the effect is as shown at right

JACK MANGARD is an enthusiastic movie fan, so I was not at all surprised one night when I approached his house to see a dazzling display of light streaming from his dining-room windows.

"Going in for animated fairy tales for the children, eh?" I remarked as I surveyed the havoc he had created with the usual arrangement of the dining-room furniture. The table was shoved over against the wall. Chairs were every which way. The stepladder had been dragged up from the cellar to serve as a high prop. With the aid of some old cloths, a liberal supply of cotton, cardboard, flour, and various odds and ends, Mangard had built quite a neat miniature winter scene, complete with a gray sky and an oversize, electric-lighted moon.

"Nothing of the kind," he answered, turning away from the finder of his movie camera through which he had been inspecting his miniature set-up. "This will be the main opening title of the Christmas movie I'm going to shoot this year. Here's how it works."

He stepped into another room and came back with a toy tractor and a row of wooden letters glued to a thin strip of cardboard so that they read, "CHRISTMAS 1936." He placed the tractor, with the string of wooden letters hooked to it, on a leaf of the table, which was balanced precariously on books placed on the arms of one of the dining-room chairs so that it was level with the surface of the table.

"You're just in time to help me work this," he went on. "I'm going to fade in on this scene by opening the diaphragm to the proper stop, and I'll hold it for about three seconds. When I give the word, you start the tractor with this lever and crawl in front of the table to the other side, keeping low enough so you won't get in the picture. Then you can stop the tractor at the pencil mark. I'll keep the camera running for three seconds on the letters and then fade out by closing the diaphragm again."

The tractor moved so slowly that there was plenty of time to get over to stop it. While it was crawling along and the movie camera was buzzing merrily, it struck me that if Mangard was going to so much trouble to film the opening title of a movie he had not yet taken, then undoubtedly he'd planned the rest of the shots for a real Christmas movie story. This proved to be the truth, and for the benefit of other movie fans his list of shots is reproduced on this page.

For a variety of good reasons, the Christmas season *(Continued on page 84)*

Fig 1

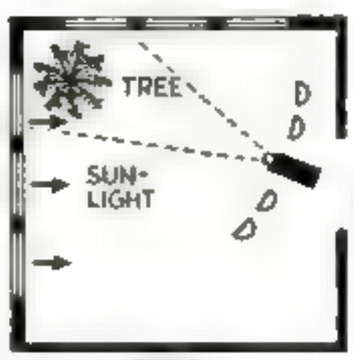


Fig 2

Fig 3

Three diagrams showing ways to light a Christmas-tree scene. At the right is reproduced the scenario Mangard wrote, which is packed with ideas you can use yourself

REAL SCENES TO SHOOT

1. Animated title, miniature winter scene with toy tractor dragging in letters spelling CHRISTMAS, 1936.
2. Close-up of Billy's hand writing "Dear Santa."
3. Medium shot of Billy and Emily writing Christmas letters.
4. Close-up of Emily writing Santa letter.
5. Billy and Emily giving letters to postman. (Note: Speak to postman about this day before.)
6. Medium shot of father opening in Christmas packages.
7. Mother wrapping Christmas packages.
8. Subtitle, CHRISTMAS EVE.
9. Children hanging up stockings.
10. Mother reading the poem beginning "'T was the night before Christmas," to children grouped around her in night clothes.
11. Close-up, over mother's shoulder, of first page of above.
12. Father bringing in Christmas tree.
13. Several close-ups from different angles showing hands decorating Christmas tree.
14. Subtitle, THE GREAT DAY BEGINS.
15. Close-up of clock with hands set at six o'clock.
16. Children getting up and running out of room.
17. Children investigating contents of stockings.
18. As many shots as desired of children opening Christmas presents around base of tree.
19. Mother putting finishing touches on dinner-table decorations.
20. Guests or relatives arriving for Christmas dinner. (Robert Ott is subtitles naming each one.)
21. Close-up of Christmas turkey being pulled out of oven.
22. Views from different angles of group at Christmas dinner table.
23. Close-ups of Billy and Emily tucked in bed for the night, each with a Christmas toy.
24. Subtitle, THE END OF A PERFECT CHRISTMAS.

KODAKS stay up late now

It's easy to take pictures AT NIGHT

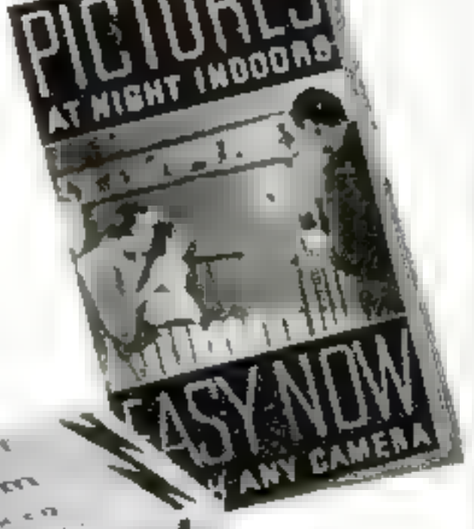
A WIZARD picture taker outdoors—but how do you rate indoors, at night? Faster films, improved lighting open a new and exciting field to your skill. There's an endless variety to indoor picture opportunities.

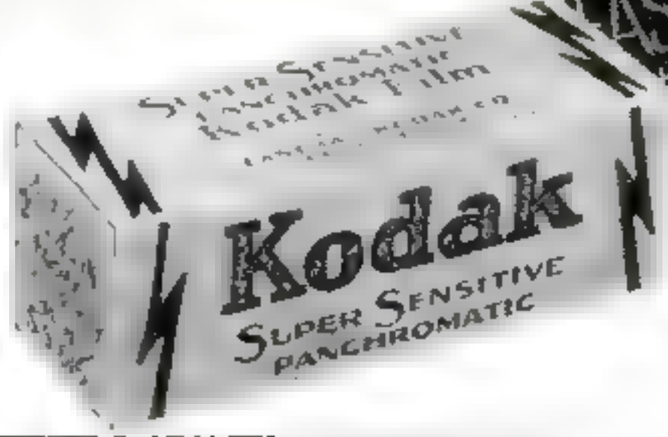
Night pictures can be made with your present camera if it can be set for "time"; and if it boasts an *f*.6.3 or faster lens, night *snapshots* are easily possible. Just load with Kodak "SS" or Kodak Verichrome Film and use Mazda Photoflood or Photoflash lamps.

No special skill or experience is necessary—anyone who can use a camera outdoors can now take pictures of the important side of life that's lived after dark—indoors.

FREE BOOKLET

First get the FREE booklet on Night Pictures at your dealer's . . . then you're ready to shoot. It explains everything about pictures at night . . . which film to use . . . how to set your camera . . . suggests a variety of picture opportunities . . . Eastman Kodak Company, Rochester, N. Y.





Accept nothing but the film in the familiar yellow box.

HOW TO TAKE YOUR CHRISTMAS MOVIES

(Continued from page 82)

provides ideal material for making a connected home movie story. It is a joyous occasion when the children, who are natural movie subjects, are sure to be wearing pleasant expressions; and it usually provides long-sought opportunities to take movies of members of the family who come visiting from a distance.

Studying Mangard's scenario from this point of view, you will see that it provides for recording virtually every high spot in the Christmas doings. Furthermore, if you allow the usual average of four feet of film (ten seconds running time) for each scene, you will see that it is possible to take this whole scenario on only a hundred feet of film. At the same time, without altering the scenario in any way, you can increase the footage to any reasonable degree merely by taking more medium and

Some simple design copied from a Christmas card may be used to decorate the subtitles

close-up shots of the children at play with their new toys (scene 18) and add increased footage of the relatives and friends (scene 20).

Naturally you must adapt the scenario both in length and selection of scenes to your own particular requirements.

Another equally important point to bear in mind is that all the scenes listed in your own version of a Christmas scenario need not be taken in the order given, nor is it even necessary to shoot them all during the actual event. In fact, you will probably find it worth while to split the scenes into two lists, one of which must necessarily be shot during the actual activities and the other listing the build-up or atmosphere shots that can be taken at your convenience a few days before or after Christmas.

Take the first eleven scenes of this scenario, for instance. You can shoot the miniature winter scene that forms the main title a long while ahead of time, just as Mangard did. And each of the next ten scenes can be posed when you have time for it. Scene 7 can be put over with the aid of some empty boxes and Christmas wrappings.

Scenes 12, 13, and those from 17 to 22 inclusive, must, of course, be taken on Christmas day, but scenes 16 and 23 can conveniently be done together a few days after Christmas. After taking the close-ups of the two children apparently asleep with their Christmas toys, the latter can be removed, the camera moved back, and the children instructed to get up and run out of the room just as they did Christmas morning.

You will find that the children will be very willing little actors in repeating for you anything they have done in connection with Christmas.

Don't be stingy with close-ups. If, for example, Billy gets a new mechanical toy for Christmas, be sure to take a close-up of the toy in action as well as a more distant shot of him playing with it. This applies with equal force to Emily's new doll. Aside from the fact that they add realism to the picture, such scenes will go over big with your own children.

Photographing the close-ups of the children writing their letters to Santa Claus will not prove a stumbling block if you see that they are supplied with extra soft black pencils and you tell them to write big and heavy because Santa is getting kind of old now and doesn't like to use his specs!

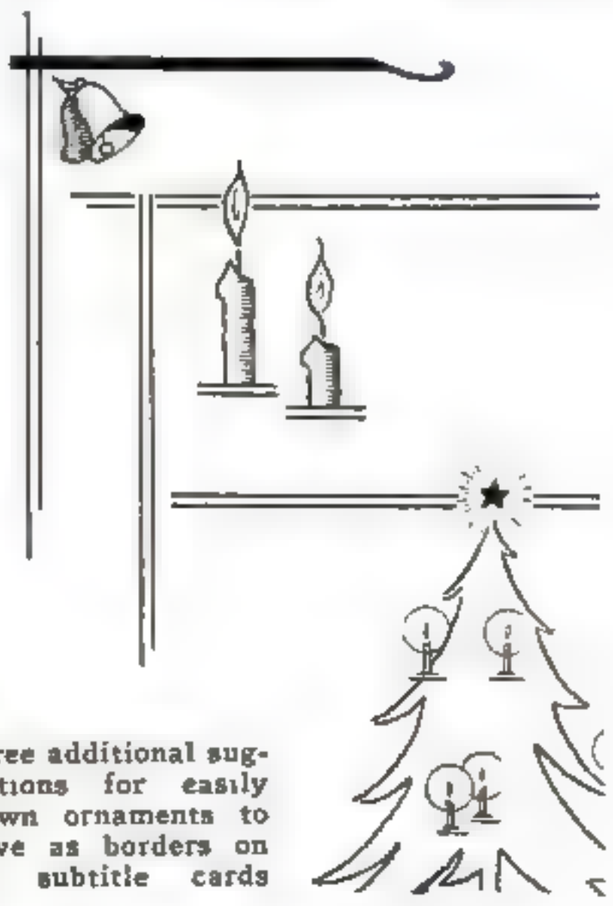
Lighting the scenes for your Christmas movies is easier than lighting ordinary indoor work in many cases, if you have daylight to help you. This is particularly true if the Christmas tree is placed in one corner of the sun parlor, as is often the practice. Indeed, the normal daylight, if the weather is fine, may be adequate for movie taking. No matter how bright the daylight may be, however, you will get better results by the intelligent use of photoflood bulbs to supplement the daylight. They will serve to brighten what would otherwise be harsh shadows and prevent that soot-and-whitewash effect so often obtained when you take indoor shots with sunlight streaming in the windows.

Do not be misled by the apparent brilliance of the Christmas-tree lighting itself. Even if you have two strings of the usual series-connected Christmas-tree bulbs, the total light from all sixteen bulbs doesn't amount to a row of pins from a movie-taking standpoint. All they can do is to add some interesting points of light and perhaps to lighten a trifle the dense shadows that would otherwise appear in the tree itself.

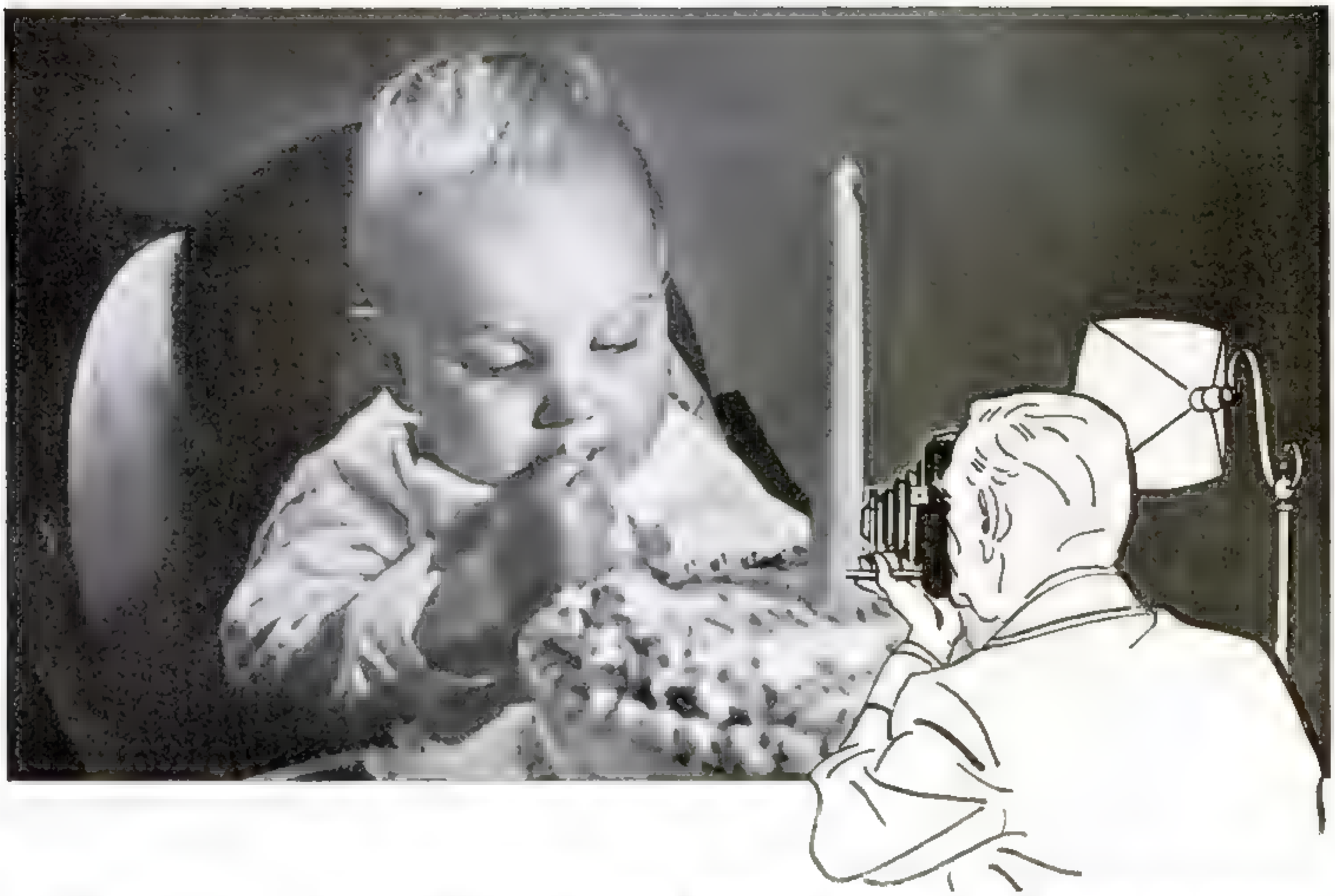
Now let us consider a few problems of lighting. First, suppose the tree is in an outer corner of the sun parlor so that no matter from what angle you shoot, a window or two will appear in the picture space. If sunlight is streaming in through one row of windows, use not less than four photoflood bulbs in reflectors so placed that they are on the opposite side of the subject. By shooting parallel to the line of windows through which the the sunlight is coming as indicated in the diagram marked Fig. 1, you will get an excellent plain lighting effect with the sunlight forming the main light and the photofloods breaking up the shadows. Under such conditions, the light coming from the windows directly in front of the lens will cause no trouble, and in most cases you will get a pleasant outdoor view through the windows.

Taking another possible camera position as shown in Fig. 2, with the photoflood lights on either side of the camera, you will get some fine back-lighted effects that will prove especially effective with children or grown-ups having fairly light hair.

If you are not in *(Continued on page 102)*



Three additional suggestions for easily drawn ornaments to serve as borders on the subtitle cards



I'm going to take SNAPSHOTS AT NIGHT *on Thanksgiving, too!*

Try some snapshots indoors or at night *with your camera.* It's fun. And it's easy...thanks to G-E MAZDA Photoflood lamps.

These bulbs provide picture-taking light from the sockets of your bridge or table lamps. And they're good for dozens of pictures.

Shoot some indoor pictures of your Thanksgiving. Or get that birthday celebration. The sooner you begin to snap pictures at night the more fun you will have. Your druggist or camera dealer can supply you with lamps. To be sure of dependable light, look for the mark Ⓖ on the end of Photoflood lamps . . . and on the disk inside Photo*flash* lamps.

Ask your dealer for a copy of "How to take snapshots at night." Gives simple, easy-to-follow directions and helpful hints. Or write General Electric Company, Department 166, Nela Park, Cleveland, Ohio.

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GENERAL Ⓖ ELECTRIC MAZDA PHOTO LAMPS

TO BE SURE OF DEPENDABLE LIGHT FOR PICTURE-TAKING, LOOK FOR THE MARK Ⓖ WHEN YOU BUY.

HERE'S WHAT YOU NEED TO TAKE THEM

Fast lens cameras—F/6.3 or faster—"SS" pan film and G-E MAZDA Photoflood lamps No. 1. 25 cents list.

Any camera that can be set for time, G-E MAZDA Photo*flash* lamps. Each lamp gets one picture. 15 cents list.

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Four DOG-BED Designs

One resembles a miniature covered wagon and another folds into a neat-looking footstool

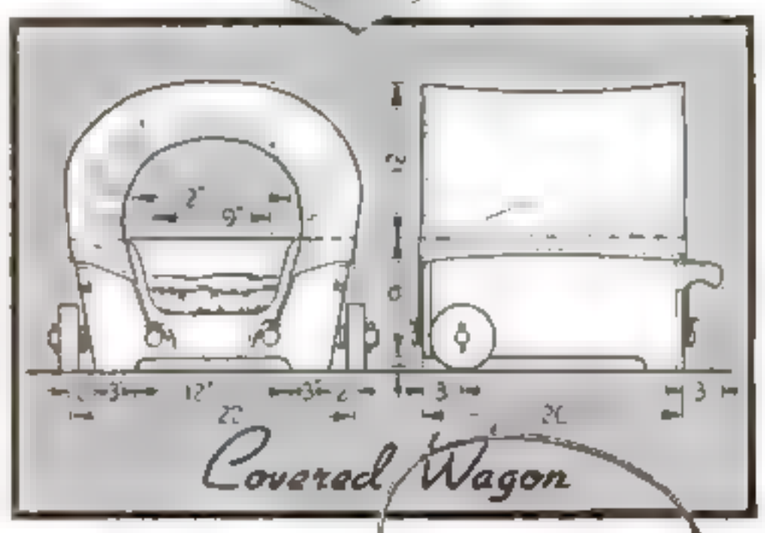
By HI SIBLEY

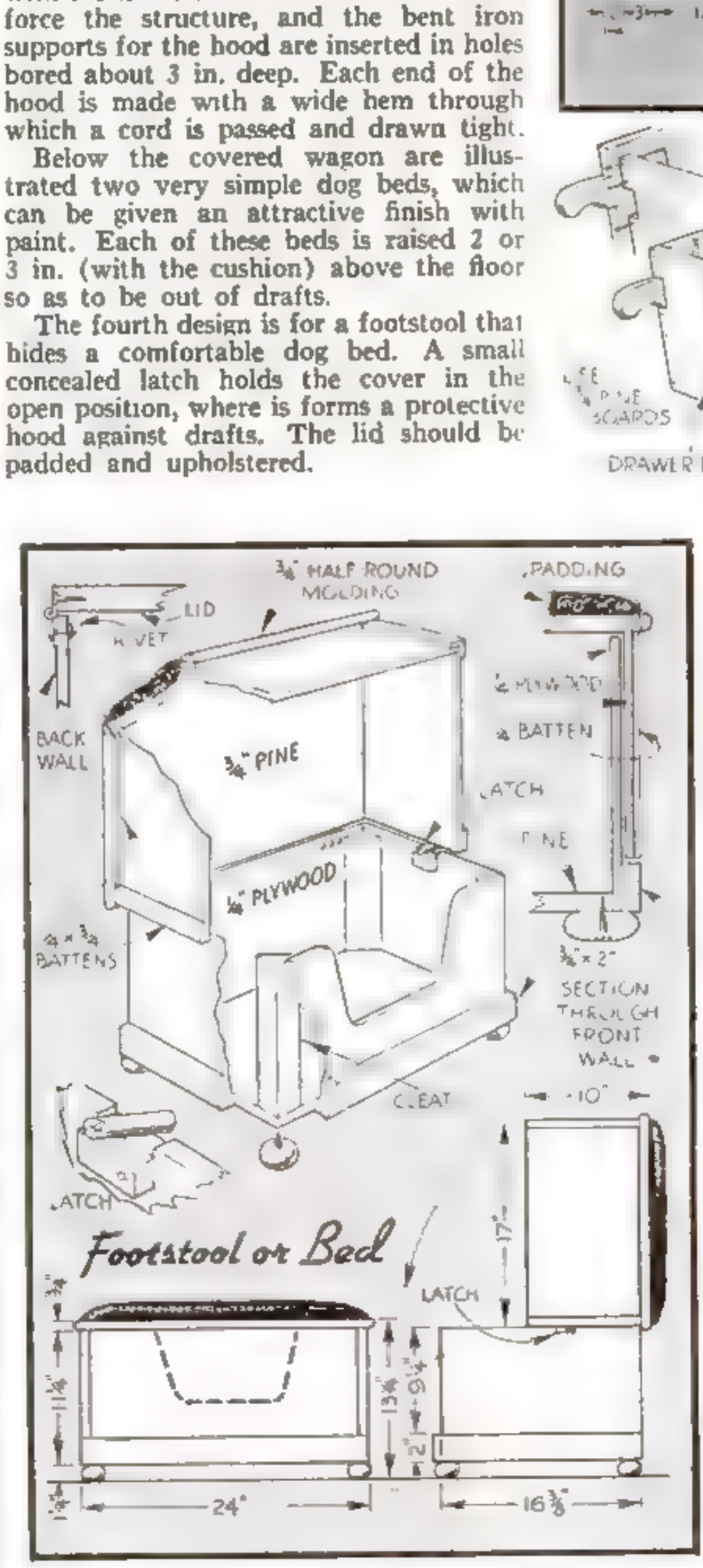
EVERY dog likes a bed that is soft and roomy, and one that protects him from drafts. Four designs are shown in the accompanying drawings, the most colorful being the "canine covered wagon," which, with its bright cushion and gayly figured hood, makes an unusually attractive piece beside a fireplace.

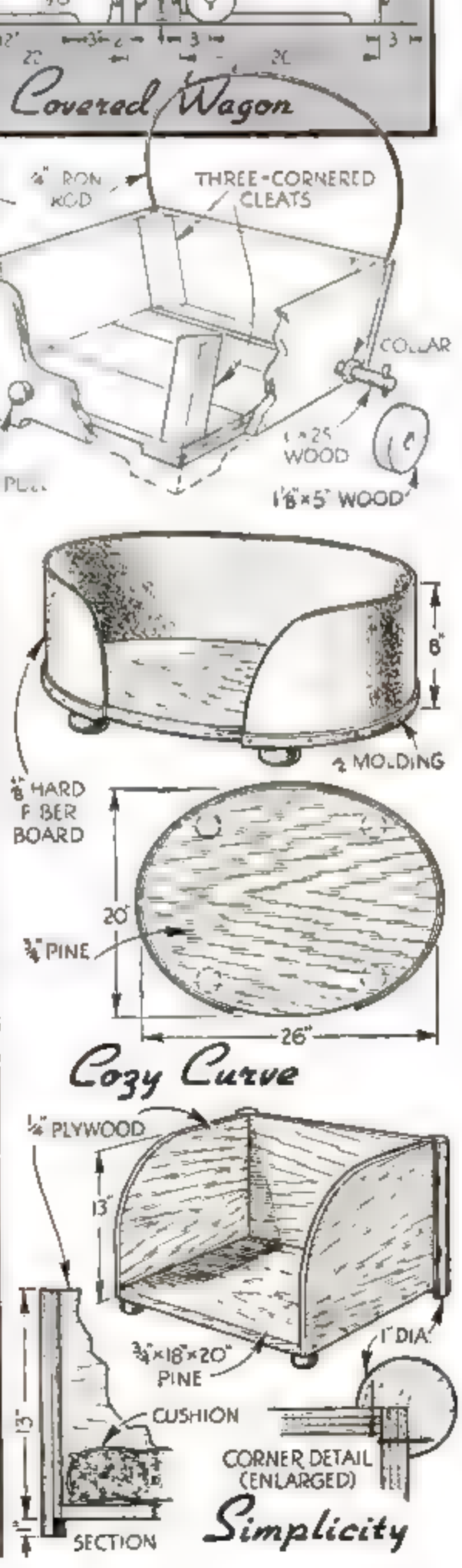
The box is constructed of ¾-in. pine and should be finished in the natural wood. Note that the front and back members are vertical, only the sides being on an angle. The wheels are cut from solid wood, and the wooden axle is set flush with the floor. Three-cornered cleats reenforce the structure, and the bent iron supports for the hood are inserted in holes bored about 3 in. deep. Each end of the hood is made with a wide hem through which a cord is passed and drawn tight.

Below the covered wagon are illustrated two very simple dog beds, which can be given an attractive finish with paint. Each of these beds is raised 2 or 3 in. (with the cushion) above the floor so as to be out of drafts.

The fourth design is for a footstool that hides a comfortable dog bed. A small concealed latch holds the cover in the open position, where is forms a protective hood against drafts. The lid should be padded and upholstered.







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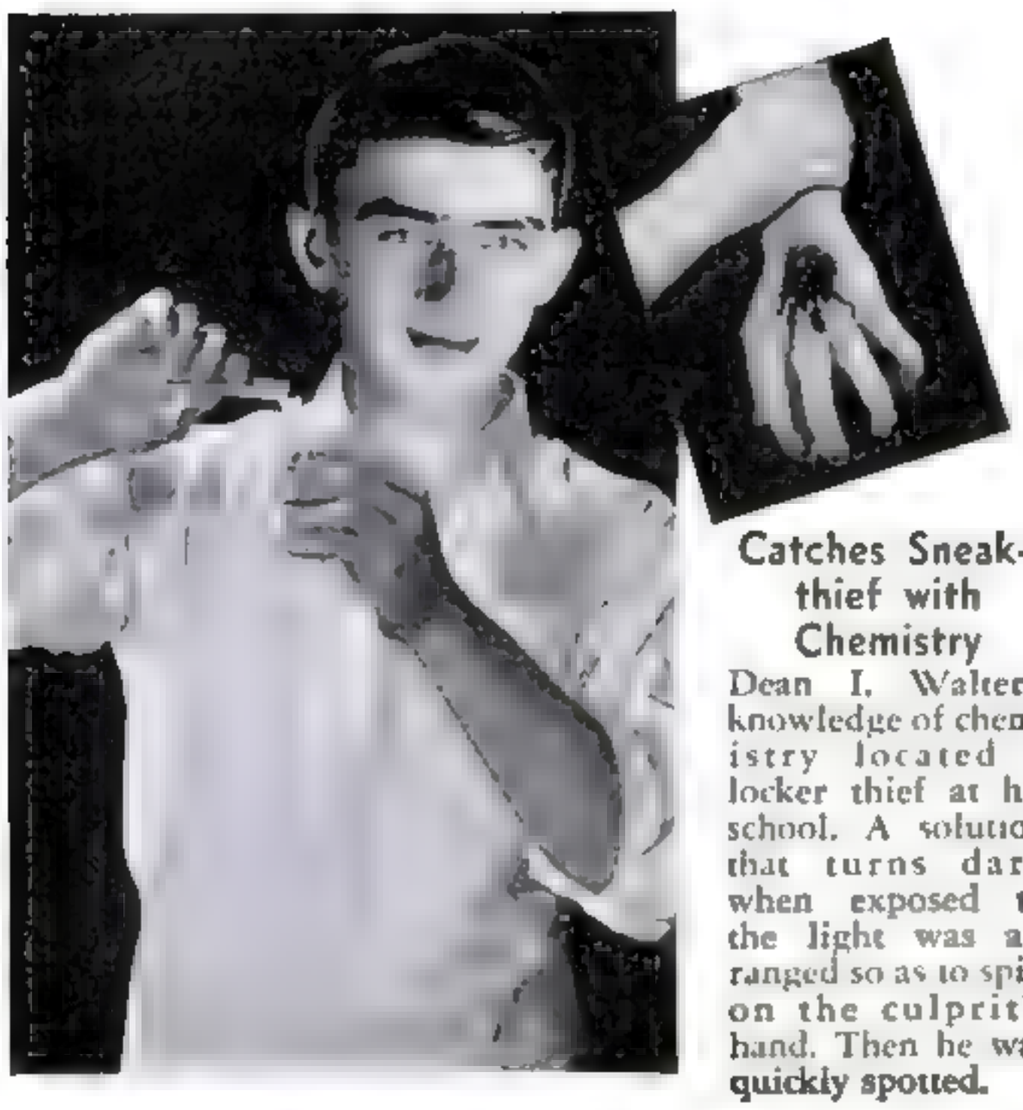

Catches Sneak-thief with Chemistry

Dean I. Walter's knowledge of chemistry located a locker thief at his school. A solution that turns dark when exposed to the light was arranged so as to spill on the culprit's hand. Then he was quickly spotted.

CAN you think of anything more exciting than having a modern chemical laboratory of your own?

Imagine Dad's surprise when you make a compound that prevents his windshield from fogging in rainy weather. Picture Mother's amazement when you make iodine; bleach flowers or transform her baking soda into washing soda. Think how your friends will gasp with wonder as you turn a lemon into an electric cell, make a chemical aurora borealis, write messages with fire ink, and perform other dazzling tricks.

The new Gilbert Chemistry Sets make you a full-fledged chemist. With each set comes an up-to-the-minute book by Professors Treat B. Johnson and Elbert M. Shelton of Yale University, describing thrilling experiments. To perform these experiments is like taking a college course at home.

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A. C. Gilbert

Inventor of Erector and maker of Kastet Kit, Opto Kit and Gilbert Tool Chests.

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- How to test yourself for "acid mouth"?
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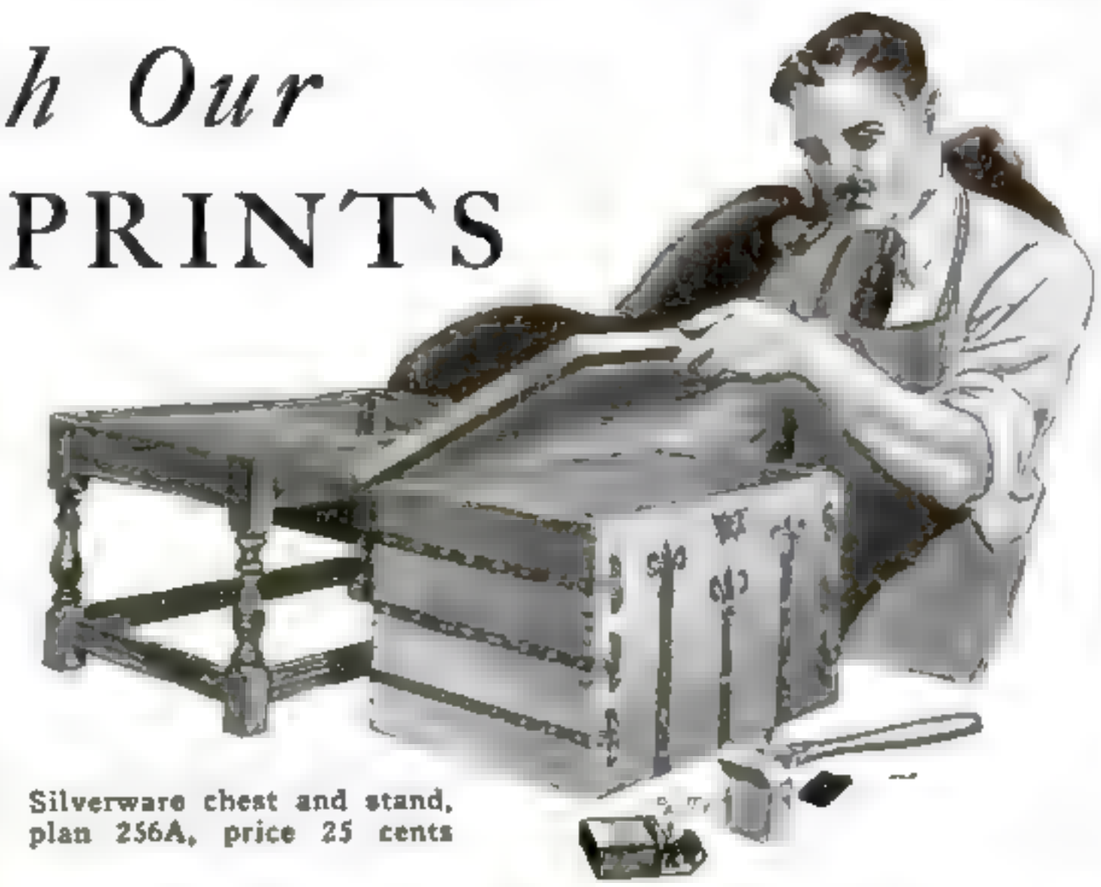

Silverware chest and stand, plan 256A, price 25 cents

TOYS, furniture, models, radios, and other projects suitable for Christmas gifts are contained in the POPULAR SCIENCE MONTHLY series of blueprints. You can always be sure that presents made by yourself will be appreciated much more than articles bought at a store. At the same time, you can derive a good deal of pleasure from making something you know is going to be used by a member of your family or a friend.

The blueprints themselves also make excellent gifts for men and boys who enjoy the home workshop hobby—for example, those subjects marked with an asterisk (*) in the following list. The blueprints, in most cases, are printed on 15 by 22-in. sheets costing 25 cents each.

This is only a partial list of the plans available. A complete list will be sent upon receipt of a stamped and self-addressed envelope.

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Drafting Table, *189A* ..... .25
*Farragut's Flagship *Hartford* (33½-in hull), *221-222-R* 1 50
Folding Duck Boat (13-ft.), *170-R* ..... .50
*Gettysburg Cannon Model (11⅝-in.), *292A-293A* ..... .75
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Sovereign of the Seas, Clipper Ship (20½-in. hull), *51-52-53-R* 1 00
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*U. S. Destroyer *Preston* (31½-in.), *125-126-127-R* 1 00
Utility Rowboat (13 ft. long), *224-R* ..... .50
*Whaling Ship *Wanderer* (20½-in. hull), *151-152-153-154* 1.00

GIFTS FOR WOMEN

Automatic Lighthouse Night Lamp and Novelty Sewing Kit, *255A* ..... .25
Cedar Chest, *17* ..... .25
End Table, American Empire, *241A* ..... .25
Gate-Leg Table, *24* ..... .25
Kitchen Table Cabinet, *27* ..... .25
Mirror Frame, *246A* ..... .25
Modernistic Folding Screens, *91* ..... .25
Mosaic Serving Tray, *297A* ..... .25
Pier Cabinet, *77* 25
Queen Anne Dressing Table, Stool, and Mirror, *295A* ..... .75
Sewing Cabinets, Priscilla and modern, *31* .25
Sewing Table, *1* ..... .25
Silver Chest on Stand (illustrated above), *256A* ..... .25
Telephone Table and Stool, *18* ..... .25
Tilt-top Table, *140* ..... .25

GIFTS FOR BOYS

*Barbary Pirate Galley (20-in.), *44-45-R* ..... .75
Clipper Ship in Bottle, *121-122* ..... .50
Cruiser U. S. S. *Indianapolis* (12-in.) 216 .25
*Flying Tractor Airplane (3-ft. wing), *50* ..... .25
H. M. S. *Bounty* (8½-in. hull), *254* ..... .25
Hunting Knife and Double-Decker Bed, *277A* ..... .25
*Kayak (with sail, etc.), *192-193-194-R* 1 00
Kite Reels, Ball-Bearing, *290A* ..... .25
Liner *Aquitania* (9-in.), *225* ..... .25
Liner *Queen Mary* (10¼-in.), *283* ..... .25
*Mississippi Steamboat *Buckeye State* (19½-in.), *94-95-96-R* 1 00
Motorboat (20-in. model), *196* 25
Oil Tanker (14-in.), *294* ..... .25
Racing Yacht (20-in. sailing model), *48-R* .50
Tie Rack, Extension Book Rack, and Turned Box, *247A* ..... .25
*Toy Motorboat (29-in.), *63-64-R* ..... .75
Treasure Chests (metal bindings), *78* ..... .25

GIFTS FOR GIRLS

Bookcase (two doors), *37* ..... .25
Card Table, Four-Leaf, *239A* ..... .25
Colonial Design Doll's House, *72* ..... .25
Doll's House Furniture, *73* ..... .25
Floor Lamp, *243A* ..... .25
Knitting Bag with Wooden Frame, and Book Ends *267A* ..... .25
Magazine Rack, Ladder-Back, *250A* ..... .25
Mayflower (24-in. model), *83-84-85-R* 1.00
Modernistic Lamps, Three, *93* ..... .25
Picture Frames and Bud-Vase Holder of Metal and Glass, *288A* ..... .25
Sedan Chair (scale model), *123-124* ..... .50
Sewing Kit (pelican design), *255A* ..... .25
Turned Costume Jewelry, *275A* ..... .25

GIFTS FOR CHILDREN

Acrobatic Monkeys Toy, *248A* ..... .25
Airplane Cockpit with Controls, *114* ..... .25
Baby's Crib and Play Pen, *26* ..... .25
Child's Costumer, *179A* ..... .25
Fire Engine and Other Toys, *101* ..... .25
Hispaniola, the Ship in "Treasure Island" (7-in.), *237* ..... .25
Jig-Sawed Birds and Animals, *56* ..... .25
Lighthouse Model, Flashing, *298A* ..... .25
Projector for Photos and Pictures, *259A* .25
Six Simple Block Puzzles, *65* ..... .25
Toy Lathe, Drill Press, Saw, and Jointer, *113* ..... .25

GIFTS FOR RADIO FANS

All-Wave Portable Receiver, *217-R* ..... .50
*Amateur Radio Transmitter, *183-184* ..... .50
*Amateur Short Wave Receiver, *155* ..... .25
*Five-Tube Short Wave (A.C. or D.C.), *223* .25
Full Electric Headphone Set, *130* ..... .25
One Tube Receiver (battery operated), *103* .25
Short-Wave Converter Unit, *137* ..... .25

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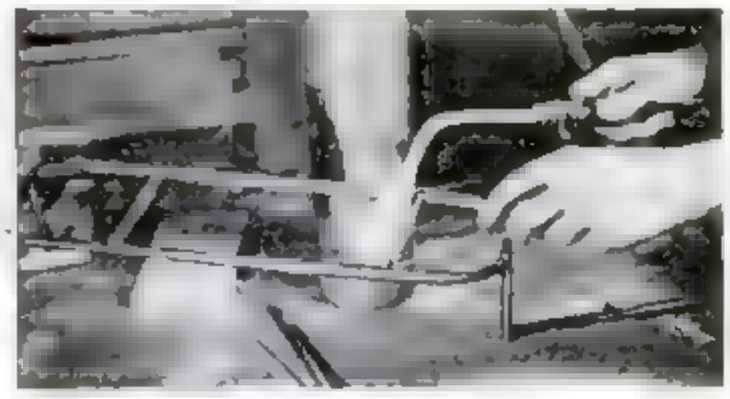
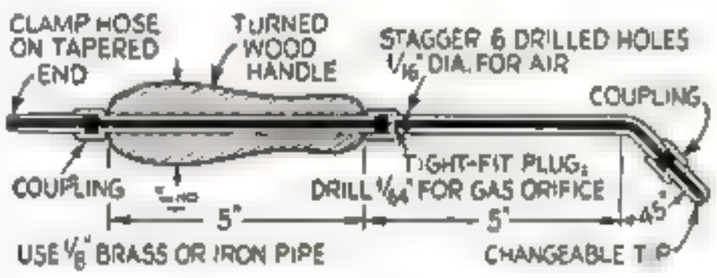


HANDY ACETYLENE TORCH FOR HOME WORKSHOP

ACETYLENE has many uses in the home workshop and is not costly if a simple torch, similar to the one illustrated, is constructed. The outfit will do brazing, soldering, annealing, sweating, and many other operations which require heat. It is not a welding outfit as pure oxygen is not used, the air being sucked in by using the principle of a Bunsen burner.

My apparatus consists of the smallest size acetylene tank, 6 ft. of ¼-in. hose, and the torch. I picked up the tank in a junk yard for a dollar, and the hose costs only about nine cents a foot.

Refills for the tank cost about a dollar. A commercial torch costs several dollars, but the one illustrated was made for a dollar. The torch's tip may be made smaller by first heating it, or the end may be plugged and then drilled to suit your needs. A coupling at each end of the handle keeps it in place. Six 1/16-in. holes are drilled in the ⅛-in. pipe to admit the air.—B. W. MORANT.



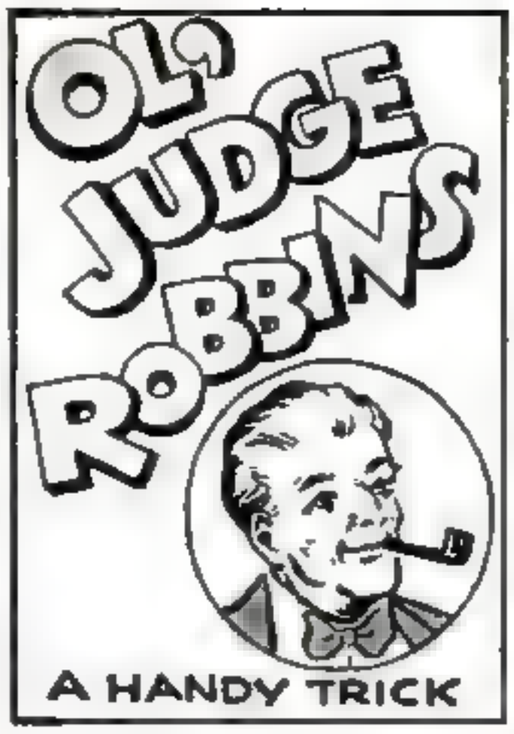
This acetylene torch is not a welding outfit, but follows the Bunsen-burner principle

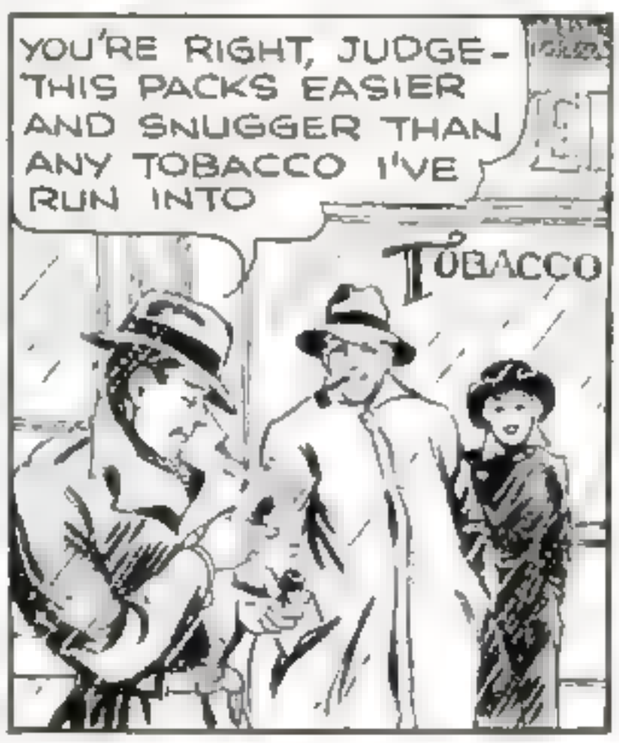
CENTERING ACCESSORY FOR DRILL PRESS

WITH this easily made accessory, many drilling, countersinking, and reaming operations that are usually done in the lathe may be performed quickly and accurately in the drill press.

The complete tool may be made in one piece from 1½-in. cold-rolled steel; or the body may be turned from cold-rolled steel, and the centering point turned from a piece of drill rod, hardened and tempered, and then inserted in a hole drilled in the body.

The body of the tool is placed in the hole in the drill-press table, and the point is lined up with the drill. Both ends of the stock to be drilled are center punched, and drilling is done as when drilling between lathe centers.—C. R. G.





Old Bill SAYS:

THE lead screw is the most accurate part of the lathe, and therefore never responsible for lead or pitch errors when one is chasing threads. Such errors in thread pitch are caused by misalignment and the camlike action caused by thrust-collar "run out." Incidentally, such errors are always minus ones.

• • •

For turning soft rubber in the lathe, a tool made from mild machine steel works better than a hardened tool. The rubber hones the soft steel to a fine edge.

• • •

Commercial dowel pins in the larger sizes are made from machine steel and case-hardened. For that reason, when large dies have been removed from die shoes or holding devices in order to be ground, the dowels should be carefully inspected to determine whether they have become bent. A bent dowel may be the cause of ruining an expensive die.

• • •

To eliminate an unsatisfactory burring operation after tapping, countersink slightly both ends of the hole in advance of tapping.

• • •

When it is necessary to remove the glazed finish from paper-base phenol fiber, immediately coat the machined surface with shellac to prevent the absorption of moisture from the air. Atmospheric changes cause this material to warp.

PLIERS AND VISE HOLD WASHERS FOR REAMING

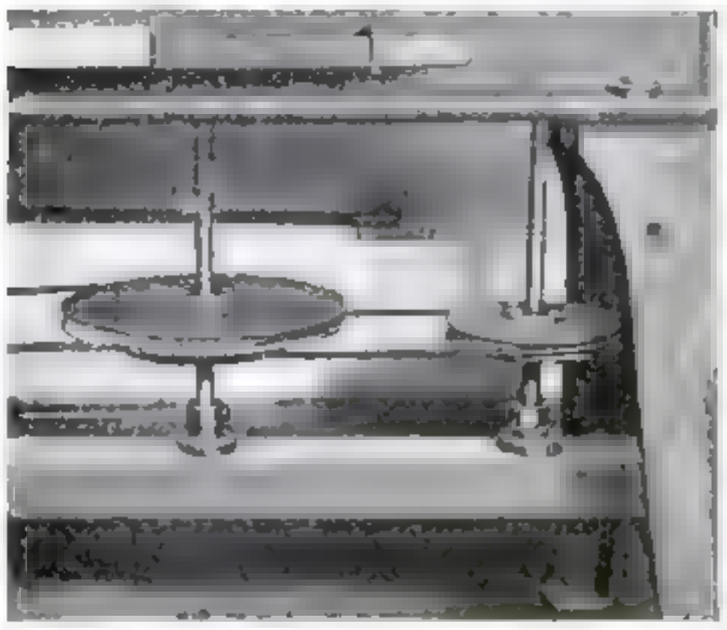
SMALL washers or burrs, which are difficult to hold when it is necessary to enlarge the holes, may be gripped with security and ease by the method illustrated. A pair of carpenter's pincers hold the small part firmly, and the pincers in turn are clamped in the vise. A washer may be held in this way regardless of how hard the drill cuts into the thin metal.—R. O. L.

AMATEUR GEM CUTTING

(Continued from page 65)

lathe or mounted on a bench and driven by a motor as suggested in Fig. 6 of the drawings.

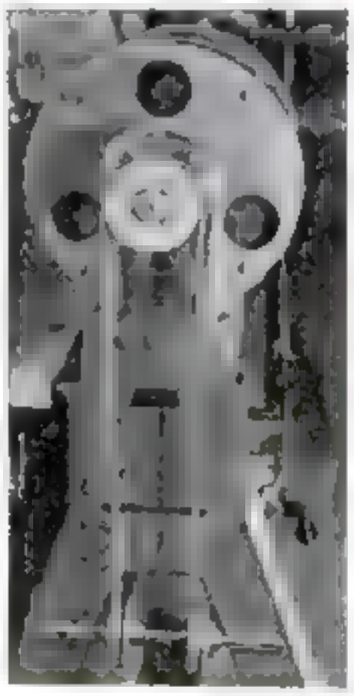
Various methods of obtaining the power may be worked out. For example, a pulley may be mounted in place of the end faceplate of the lathe illustrated in a cut below. Idler pulleys (Fig. 5) may be any size. Then by using different size pulleys and a ¼- or 5/16-in



Method of mounting the two vertical spindles under a lathe bed. The pulleys are of wood

round belt, two vertical shafts can be made to revolve at a speed of from 150 to 200 r.p.m. in a counter-clockwise direction. It is upon an outfit very similar to this one that many if not most of the *cabochons* and small cabinet display specimens shown at U. S. National Museum, Smithsonian Institution, are ground.

The shafts (see Fig. 7) are ¾-in. cold-rolled steel, threaded on top with N.C.(U.S.S.) thread so that the cast-iron laps or faceplates can be easily attached. The plates should be about 8½ in. in diameter and about ½ in. thick after being machined. A drawing for the pattern, which is made of softwood, is given in Fig. 8. Make the pattern and have several cast in iron at a foundry. If blowholes are encountered in machining, do not throw the plate away. They may be filled by using an acetylene torch or even by plugging with lead.



A wooden pulley is mounted in place of the end faceplate on the lathe, and the belt passes over two small idler pulleys

In using this attachment, the grinding wheel and internal grinders are dispensed with, as all grinding is done on the cast-iron laps, using first the 100 grit mixed with water, followed by FF, then 600 grit. Polishing is done the same as in the other method.

Although one shaft and one faceplate will do if the abrasive is washed off the plate each time before using a finer grade, it is more convenient to have two face-plates in motion at once in order to save time.

For the 600 grit a hardwood faceplate may be used with excellent results. If this plate is grooved, it will aid materially in polishing small *cabochons*. Felt may also be fastened to a wood plate.

In using abrasives around machinery, it is important of course, to cover the bearings well so that none of it can get into them.

Stones used in jewelry, generally speaking, are divided into two groups, precious and semiprecious. Five *(Continued on page 92)*

AMATEUR GEM CUTTING

(Continued from page 91)

stones are generally recognized as precious: diamond, sapphire, ruby, opal, and emerald. Pearls are sometimes classed as precious stones, although they are of organic origin.

In the semiprecious group are many native stones and minerals. Among our native ones that work into excellent *cabochons* are: variscite (bluish-green); rose quartz (deep pink); jasper (red, also brown); jasper, orbicular (red, yellow, brown); carnelian, (red, translucent); sard (brown); agate (blue, gray white, and banded); rhodonite (pink); Mexican onyx (white and with brown streaks); turquoise (blue); plasma (greenish); and epidote (green and red).

Sodalite (blue) from Canada; lapis lazuli (deep azure-blue) from Chile; Amazon stone (blue-green) from Madagascar, and malachite (green) from Belgian Congo are some of the minerals from other countries that are highly prized as semiprecious stones.

Gems are measured in hardness by Mohs's scale, which contains ten minerals from the softest to the hardest. This scale is: 1. Talc; 2. Gypsum; 3. Calcite; 4. Fluorite, 5. Apatite; 6. Feldspar; 7. Quartz. 8. Topaz; 9. Corundum, (ruby and sapphire); 10. Diamond.

Quartz contains the largest group of gems. In this group we find rose quartz, chalcedony, carnelian, jasper, tiger eye, sard, plasma and the agates.

Turquoise is 6 in hardness; lapis lazuli and sodalite are around 5½; variscite around 4½, and the beautiful malachite, which is very soft, is only 3½ in hardness.

After you have successfully cut, ground, and polished a few cabochons, *you will want to mount them in rings, pins, brooches, or other jewelry. Full instructions for doing this were given in a previous article (P.S.M., Oct. '36, p. 76).*

STEP-DOWN TRANSFORMER

(Continued from page 77)

Wind 550 turns of No. 22 D.C.C. (double cotton-covered) magnet wire on a wood form to serve as the primary winding. A suitable winding form is shown in Fig. 1. This consists of a wood block 1⅛ by 1⅛ by 2¼ in., and two thin wood ends, 2⅝ by 2⅝ in., held together by a crank-shaped threaded rod. Saw slots from the outer corners, extending toward the center and into the center block to provide for tie wires. Place about 10 in. of any small size wire in each slot in the wood center block and allow them to extend beyond the end blocks. Wrap several layers of thin cardboard around the center block, and proceed to wind the coil. A small piece of pipe placed in a vice will support the form while the coil is being wound. When 550 turns have been wound, bring the ends of the tie wires through the slots in the end pieces and twist them together. Remove the coil carefully from the form and cover with shellac or melted paraffin to serve as a binder. When the binder has hardened, attach a piece of lamp cord to the coil ends, and tape the coil with cotton or friction tape.

Placing the end laminations in the core

The secondary coils are wound directly on one of the taped core sections. Place a strip of friction tape along the core and fold one end back around *(Continued on page 93)*

STEP-DOWN TRANSFORMER

(Continued from page 92)

the starting lead. The following turn of wire will pass over the end of the tape and hold the coil firmly in place. For the transformer having adjustable voltages, wind 11 turns of No. 16 D.C.C. magnet wire on the core section and bring out a twisted lead, as shown in Fig. 2. Wind 11 more turns, bring out another twisted lead, then wind on 33 turns. The end of this 33-turn coil, when twisted with the start of the next coil, will serve as the center tap of the transformer. In winding the remainder of the secondary coil, 33 more turns

Tightening the end clamps on the core, after which it is necessary to add terminal screws

are required, then two more coils of 11 turns each, with a twisted lead brought out from the end of the 11-turn coil next to the second 33-turn coil.

When the winding is completed, there should be two single leads and five double leads extending from the winding. Each layer of winding should be held in place with a strip of tape, as was done with the starting layer. It is advisable to tape the twisted leads where they pass between the turns of wire to prevent a possible short circuit at that point. Tape the winding, place the primary coil over the other taped core section, and insert the short laminations in place, one half of the total number going on each side. The short laminations are alternately placed in the spaces between the long laminations until all spaces are filled (Figs. 2 and 3).

Cut and drill four end clamps (Fig. 4) and provide threaded rods (Fig. 5) to hold them in p'ace. Place the clamps on the core and mount the transformer as shown in Fig 3. Provide seven terminal screws and connect the secondary terminals to the screws. Mark the terminals to indicate the voltage of each. When not used in conjunction with the rectifier, the transformer makes an excellent general utility transformer delivering from 2 to 20 volts in steps of 2 volts. Approximately ¾ lb. of wire will be required for the primary coil, and ½ lb. for the secondary coil.

If it is desired to use the transformer in conjunction with a small size, or 2-ampere battery-charger bulb, it will be necessary to wind a different number of turns on the secondary coil. Start the winding as outlined above and wind 75 turns of No. 18 D.C.C. magnet wire on the core. Make a twisted lead and wind 11 additional turns of No. 14 D.C.C. magnet wire. The larger wire connects to the filament circuit of the battery-charger bulb, as shown last month. In winding both of the transformers just described, make certain that all of the secondary coils are wound in the same direction.

Use our blueprints for making your Christmas gifts. A variety of ideas are contained in the list on page 88.

PORTABLE BOX OFFICE FOR SCHOOL HALLS

THIS reserved-seat ticket rack aids in efficiently distributing tickets for a small school auditorium of about 700 capacity. It is used in a down-town store until shortly before the performance, when it is removed with the unsold tickets still in their slots to the auditorium for door sales. The purchaser can visualize just where his seats are located, and the ticket seller can see at a glance where blocks of seats are available. If there are several performances, tickets of distinctive color for each are printed and kept in the same slot.

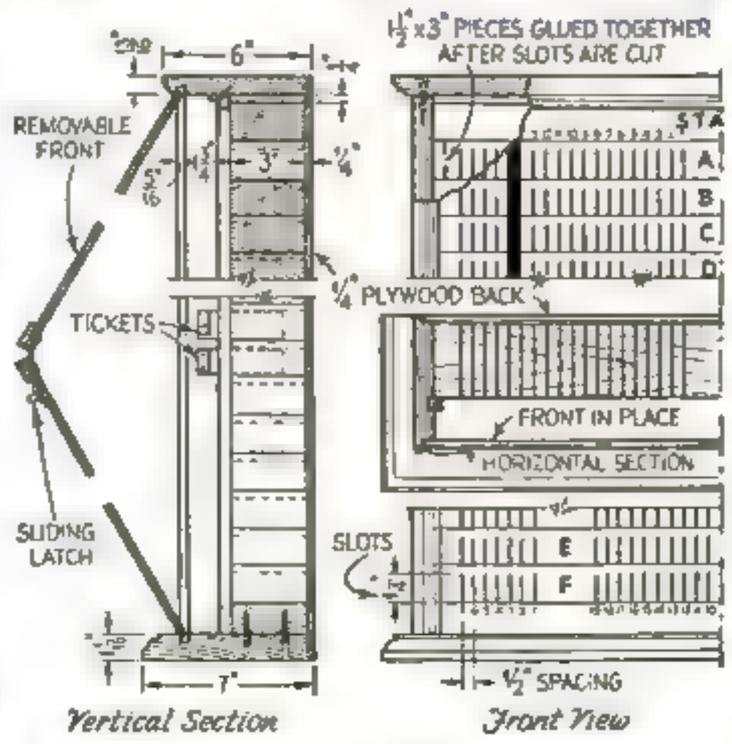
The case may be made of white pine, but hard balsa wood is better for the slotted block to reduce the total weight.

First survey the seating and work out on paper the best arrangement of slots. Separate the slots to show the aisles, and segregate the main floor seats by a heavy black line. Slots about 1¼ in. high and 3/32 in. wide. (the thickness of a circular saw cut) will fit the common size of reserved seat tickets. Check this with your printer. Space the slots about ½ in. on centers.

How the folding cover slides in place and, above, the ticket rack in upright position

After settling on the layout and determining the over-all size of the case, dress up the proper number of 1½ by 3-in. pieces and clamping them together, mark carefully the location of the slots. Cut the slots on the circular saw. Then glue all these pieces together into one solid block, and square and surface it on all sides.

Now build the frame around this body block, screwing only the base to the body and leaving an open space at the top. This enables the block to swell and shrink. It is guided between the ¼-in. plywood back and a ½-in. square hardwood strip grooved in each side member as shown on the drawing. The open space left at the top for expansion is concealed with a molding secured to the frame. *(Continued on page 95)*



Before cutting the slots for the tickets, the seating arrangement must be laid out

PORTABLE BOX OFFICE

(Continued from page 94)

As shown in the illustrations, the removable front of ¼-in. plywood is in two pieces, hinged horizontally in the middle. The ends slide into 5/16-in. square grooves in both head and base pieces, and the sides lie in 5/16 by ⅜-in. rabbets in the side members. When the folding front is in place, it is secured by small sliding bolts, one at each side near the joint. The dimensions of the sides and block should be so established that the tickets will be held in their slots when the front is in place. The whole case can be carried from place to place by a handle on one side.

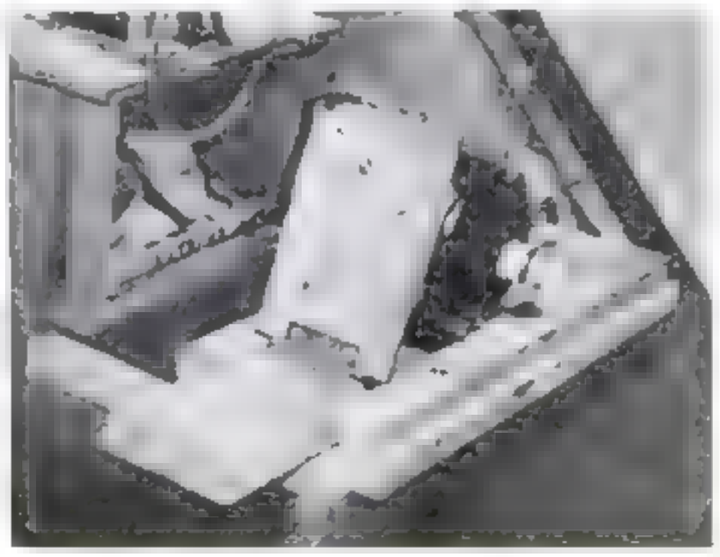
Give the face two coats of clear shellac and rub smooth. Obtain the services of an expert letterer or sign painter to put on the numbers and section letters. This may be done with India ink. Protect the lettering with another coat of shellac. Stain and varnish the outside.—D.A.P.

MOTOR ON MOVABLE BASE SERVES TWO MACHINES

BY ATTACHING a small electric motor to a sliding mount, it can be used to operate several machines without the usual bother of unbolting and shifting it to a different position. The photographs show how one motor was placed so that it will run either a lathe or a jig saw.

For a similar set-up, mount the machines with the jig saw higher than the lathe so there will be no interference between their pulleys and belts. Make a wooden base for the motor with edges at a 45-deg. angle, build a slide to suit, and fit the base and slide together into two guides about 1 ft. long. If you prefer, the motor may be hinged to the base as shown in order to provide for floating belt tension.

By sliding the motor back and forth, proper belt adjustments may be made, while the sidewise movement will bring the motor into line with any one of the three-speed lathe pulleys or with the jig-saw pulley. If the floating tension is not desired, the motor may be fastened directly to the base, and a catch provided to hold it.—LESTER H. HINDLE.



The motor base may be hinged to the slide in order to provide for floating belt tension

GUILD CLUBS RUSH WORK ON CHRISTMAS TOYS

ONCE again the home workshop clubs of the country are engaged in their philanthropic activity of making toys to be distributed to needy children of their communities at Christmas. Each year the number of toys given away increases, and the clubs hope to break all records this season

Many local hardware and lumber dealers are cooperating in the enterprise by donating materials. In most cases the clubs plan the work far in advance and then hold several meetings when the members combine their efforts and tools to turn out the toys in mass production. Hundreds of toys have been made in this way by a single club. Some of the clubs, however, let the members construct anything they please, and in this way gather together a smaller but much more varied collection of toys. Quite a few of the clubs also give their services in reconditioning old toys collected by various local agencies.

Saginaw (Mich.) Homecraft Club. The fall schedule started with a big booster meeting. . . . A toy-building program is progressing rapidly through the help of several local lumber yards and stores, which are furnishing scrap cuttings of plywood and other materials needed.

An exhibition given by the Wichita (Kans.) Homecraft and Hobby Club in a store window

St. James Workshop Club, Montreal, P.Q., Canada. Several of the members did special work last summer in order to raise money to purchase machinery and tools for the club workshop. At present, toys are being made for several charity organizations, which will distribute them during the holidays.

Ocala (Fla.) Homeworkshop Club. The main objective for the balance of the year is the making of toys to be donated to the underprivileged children's tree sponsored each year by the local Lions Club. Several members brought models of toys to the first meeting in September, and the one selected was a wheelbarrow made by Lewis Smith. A committee was appointed to purchase the material, and twenty-five wheelbarrows were made at the next meeting. The club expects to make at least 100 toys.

Fargo (N.D.) Homecraft Guild. Moving pictures and a talk on abrasives and their use were given at a recent meeting by a representative of one of the leading abrasive manufacturers.

Capital Homecraft Club, Washington, D. C. The second annual exhibition was held the latter part of October. . . . E. W. Parks has been elected treasurer to fill the vacancy left by the resignation of Edwin S. Houck, who is unable to attend meetings. . . . A recent session was held in the workshop of Andrew W. Bennett. Members were invited to bring any uncompleted projects and finish them there, as he has a complete outfit of hand and power tools. *(Continued on page 97)*

GUILD CLUB ACTIVITIES

(Continued from page 96)

Cartier Homeworkshop Club, Montreal, P.Q., Canada. "What's Photography?" was discussed by Georges Frenette, club photographer, at the home of Jean Tremblay. Paul Denis explained plans for making models of the *Sovereign of the Seas* and the C.N.R.'s locomotive No. 6400. Mr. Frenette displayed plans for the C.P.R. locomotive No. 3000 and its trail wagons. Maurice Latreille is completing a set of model airplanes and a miniature locomotive 30 in. long.

Brockton (Mass.) Homeworkshop Club. Although the club as a whole was inactive during the summer, several of the members worked on various projects. One member erected a fence and arbor for his garden. The secretary recently moved to another part of the city, and the members coöperated in setting up his shop at its new location.

Roswell (N. Mex.) Homeworkshop Club. E. J. Kurre has been elected president of this new club; Mills Talmage, vice president; Dr. H. S. Rouse, secretary-treasurer. Meetings are held on the first Tuesday of each month at the homes of members. Plans are being made for an exhibit at the Eastern New Mexico State Fair.

Cabway Lingo Homeworkshop Guild, Missouri Branch, W. Va. Located in the state park for which it is named, this club has a charter membership of twenty-five C.C.C. men. Harry McClure is president; Virgil Scaggs, vice president; Drewey Byrd, secretary-treasurer. Hugh M. Day is educational adviser.

Berkshire Homeworkshop Club, North Adams, Mass. Members gave talks on "Simple Wood Turning" and "The Importance of Following Plans" at a recent meeting. Pictures were shown on a screen with a projector made from Guild plans. A demonstration on making mortise-and-tenon joints was given.

Covington (Ky.) Homeworkshop Guild. Joseph Hackman has been elected president; Henry Stark, vice president; Harrie W. Johnson, secretary; Charles Zimmer, Jr., treasurer and librarian. The board of directors consists of Marshell Herst, C. W. Peters, E. S. Schonk, and Carl Knoeckelman.

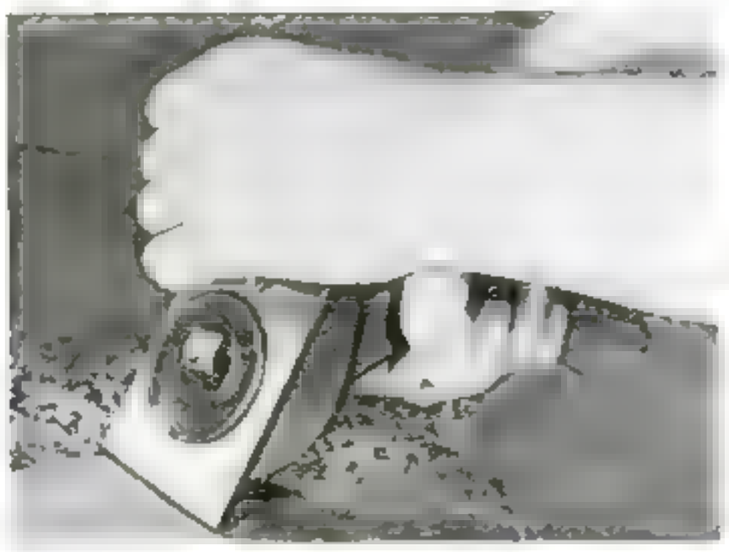
Cavalier Homeworkshop Club, Pittsburgh, Pa. A dance will be held to raise money to purchase lumber for several club projects.

Club des Artisans Amateurs, Trois Rivieres, P.Q., Canada. The club is operating by sections under the direction of chairmen as follows: furniture making, S. O. Balleux; fancy craftwork and fretwork, Albert Ricard; model making, Albert Chartier. The chairmen make reports at the monthly general meetings. The final one-member exhibition was held by J. Henri Dubé, who exhibited a model of the *Sea Witch.*

Orchard Park Home Work Club, West Lynn, Mass. During the summer, the club made weekly trips with the junior members to visit various industries. Among the places visited were a poultry farm, dairy farm, naval station, milk-distributing plant, ice cream factory, newspaper office, radio broadcasting station, job-printing plant, Fort Banks in Boston harbor, electrical manufacturing plant, wild animal farm, ship building concern, and railroad freight terminal. A picnic ended the summer activities. Many of the juniors are studying printing under the direction of the president, Donald William Fraser.

Union County Craftsman's Guild, Elizabeth, N. J. "Chips" is the title of a club bulletin recently started. Plans have been started for the annual exhibition. The meeting place formerly used by the club at the Y.M.C.A. has been abandoned in favor of the members' shops, some of which are exceptionally well equipped with tools and machines.

HEAVY-DUTY SCRAPER HAS PISTOL GRIP



HERE is a general purpose hand scraper that, because there is more "turn" on the blade, cuts deeper than the cabinet type of scraper and makes an excellent tool for removing old paint and varnish preparatory to refinishing. Many floor finishers prefer this solid construction to the ball-and-socket type.

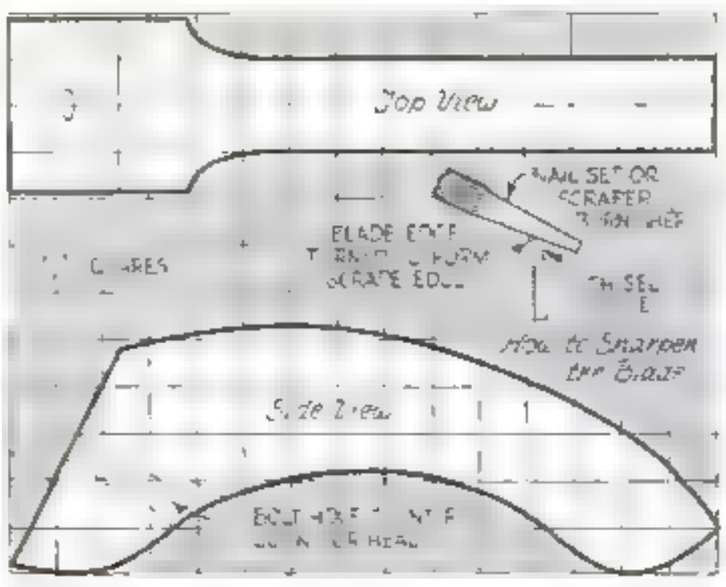
The handle is cut from a block of hard wood about 1¾ or 2 in. thick. The blade may be a standard scraper blade or it can be cut from a discarded handsaw. A handsaw blade makes excellent scraper steel, as it seems to have just the right degree of temper and toughness to hold an edge well. To cut this material, the blade is marked with a file at the correct location and then, after being placed in a vice, is snapped off with a hammer and a block of wood. The hole is made by sandwiching the blade between two plates of heavy scrap metal having coinciding holes and then punching the saw steel out. Ream the hole to the desired size.

Corners of the handle should be rounded off

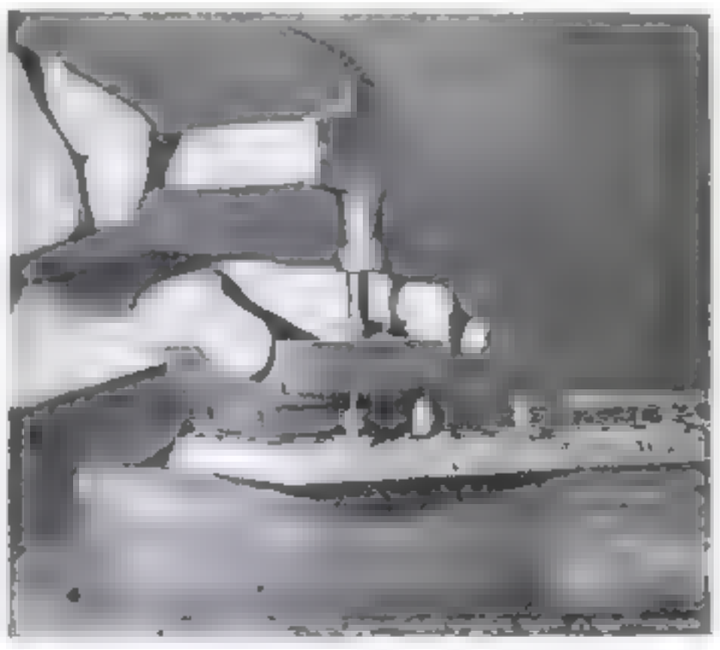
The correct degree to which to turn the blade must be determined by experience. While a smooth, filed edge will suffice for rough work, an oilstoned edge will give a smoother surface and stand up longer. The method of sharpening and turning the edge is shown in the drawing.

A large washer is placed over the blade to stiffen it and eliminate chattering. A regular nut is preferred to a wing nut, and for working in close quarters, any of the bolt that projects past the nut should be hack-sawed off. The curved handle affords a good grip and will not pull out of the hand.

This type of scraper gives better satisfaction on hard wood as it has a tendency to tear the fiber of soft wood, which means extra sandpapering.—R. O. LISSAMAN.



Diagrams showing how to cut the handle, and the method of turning the edge of the blade

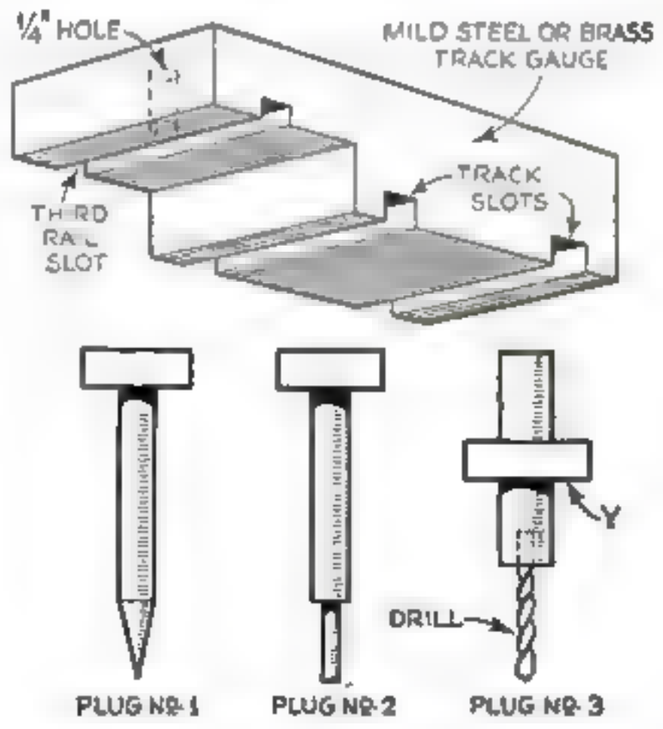


THREE-WAY TRACK GAUGE FOR MODEL RAILROADS

THIS three-way model railway track gauge serves to make the hole in the third-rail tie for inserting the insulator pin, for driving the pin down to the correct height, and as a steady rest and jig for drilling holes in the third rail. It also serves as a continual check on the gauge of the track.

All that is required to make this gauge is a block of mild steel or brass and 7 in. of ⅜-in. cold-rolled steel rod. Face one side of the block with a lathe, shaper, or file. Mark out and file or mill the slots for the rails. In the middle of the block directly over the third-rail slot, drill a hole which will be a sliding fit for a piece of ¼-in. drill rod. Be careful to get the hole accurately placed.

The three plugs are turned from one piece of rod at the same time. The first plug is for making the hole in the third-rail tie for the insulator pin. The narrow part is a sliding fit in the hole made in the track gauge, the length being determined by the distance the pin must be driven. The second plug is made in the same way and should be just long enough so that when the shoulder is resting upon the track gauge, it has driven the pin with the insulator on it solidly into the wood. The third plug has a hole drilled in it to receive a No. 55 or 60 drill, which is soldered in place. The length from the bottom of the collar *Y* to the point of the drill is the distance necessary when the collar *Y* is resting flush on top of the gauge and the bottom of the drill has just passed through or cleared the bottom of the third rail.—JACK WHEELER.

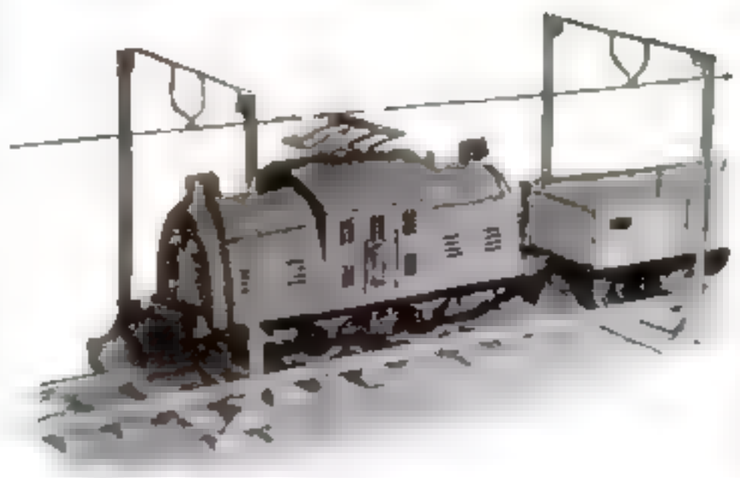


The gauge block fits over the track, and the plugs are used for installing the third rail

PORTHOLES FOR SHIP MODELS

SHIP-MODEL portholes that appear to have glass in them may be made from eyelets. Place a sheet of thin celluloid on a soft pine block and drive the eyelet through the celluloid far enough to leave a glasslike disk firmly fixed in the middle.—H.T.

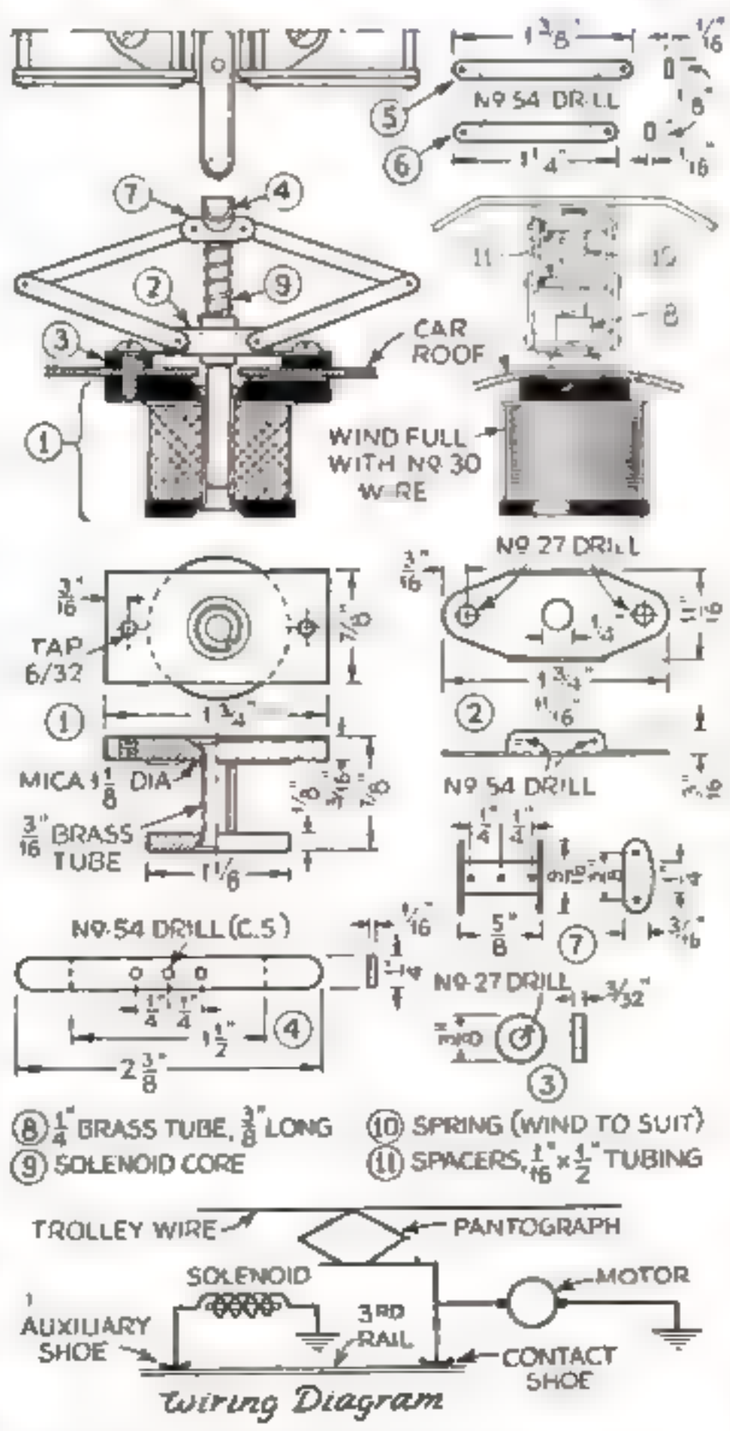
AUTOMATIC PANTOGRAPH FOR MODEL RAILWAY



SIMULATING the action of pantographs used on full-sized locomotives, this small model remains folded while power is being drawn from a third rail and rises when a section of track fitted with an overhead wire is reached. This automatic operation is obtained by a solenoid mounted inside the cab and energized through an auxiliary contact shoe touching the third rail.

The dimensions shown are suitable for use on a standard gauge model operating on alternating current and can be modified as desired with the exception of the solenoid. The specifications and dimensions given for the winding are the result of many tests and are an effective compromise between strong pull and low operating temperature. It is essential that the solenoid core be slotted as shown, otherwise induced eddy currents will cause excessive heating. The plunger *(9)* is made from soft iron with a short piece of No. 14 copper wire soldered in one end. This wire is then riveted to the contact arm *(4)*.

Three holes in the locomotive cab are necessary for mounting. They should be large enough so that neither the mounting screws nor the plunger will touch the metal roof. A piece of rubber-covered wire fastened under one of the mount- *(Continued on page 101)*



Wiring Diagram

Assembled pantograph, details of the various parts, and a diagram showing the connections

AUTOMATIC PANTOGRAPH

(Continued from page 100)

ing screws and run down to the regular contact shoe carries power from the pantograph to the motor. No dimensions are shown for the auxiliary contact shoe since these will depend on the space available for mounting it.

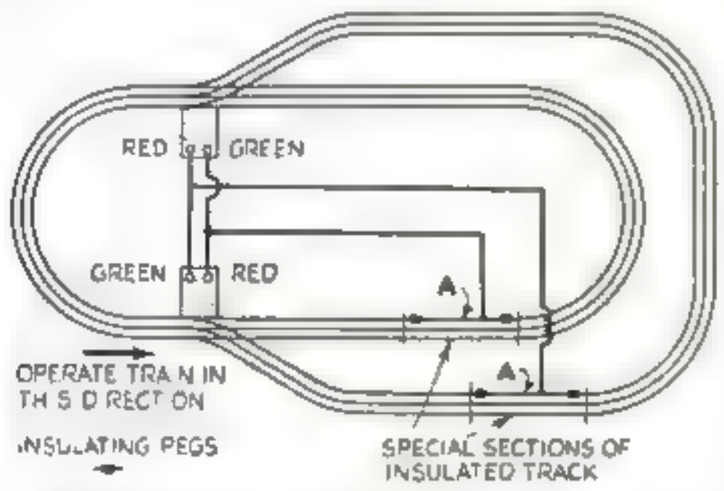
If the track is laid out so that the overhead wire overlaps the third rail slightly at each end, the change-over will be accomplished without any change in the speed of the train, and since the motor circuit will be open only momentarily, the remote control reversing mechanism will not operate.—H. W. DRYDEN.

Underside of locomotive with auxiliary shoe for getting power from third rail

MODEL TRAIN CHANGES ROUTES BY ITSELF

BY INSULATING certain portions of the track in a model railway system and installing a pair of remote-control switches, it is possible to have the switches automatically operated by the train itself so that the train alternately takes one route, then another. Although especially designed for small layouts, the scheme works equally well when used with larger sets.

Lay out the system as shown in the diagram. Each end of the installed inside rail of the insulated section is provided with a fiber pin, which insulates it from the rest of the



Although designed for small layouts, this arrangement will work on larger sets also

rails. This rail *A* should be separated from the ties by some nonconducting material.

The system operates as follows: Start the train at the left curve in the direction indicated, letting it take either route. When the engine wheels roll upon the insulated tracks, an electric circuit is completed which follows the wire from the rail to a terminal of one switch and the opposite terminal of the other switch. This changes the switch that the engine is approaching in order to let it through and also changes the switch just passed so that the train will take the other route the next time. Be sure that the insulated section of track is far enough ahead of the switch so that all the cars will pass over before the engine automatically causes the direction of the switch to be changed.—ROBERT WEST.

NONSLIP YARDSTICK FOR GLASS

A YARDSTICK used for cutting glass can be prevented from slipping by cementing to the underside a strip of rubber cut from an old inner tube.—EMIL J. NOVAK.

• • •

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YOUR CHRISTMAS MOVIES

(Continued from page 84)

a position to use any strong artificial light, then the best solution is to see that the tree is placed away from the windows as shown in Fig. 3 so that you can take movies from the outer corner of the room in the angle formed by the two rows of windows. This arrangement will give satisfactory results, although you will probably find that the upper part of the picture appears darker than the lower portion. This effect can be counteracted to some extent by spreading a white cloth or sheets of newspaper all over the floor so that more light will be reflected upward. Be careful not to get the cloth or newspaper in the camera's field of view.

The various problems of artificial lighting for movies and still pictures have been covered in many previous articles so that it seems unnecessary to go over this ground again in connection with lighting the other scenes in your Christmas movies that do not involve the Christmas tree.

The lighting of the miniature scene that forms the main title will depend on the scene you build and the effect you want.

As worked out by Mangard, it was a moonlight effect. One of the photographs shows the actual set-up as it was being filmed; another shows how it looks on the screen. The whole scene was lighted by indirect light reflected from the ceiling of the room, a No. 4 photoflood bulb being pointed straight upward (equivalent to four ordinary photoflood bulbs). The moon consisted of a hole in a piece of gray cardboard behind which was placed a piece of opal glass, and directly back of that was a photoflood lamp. The camera was operated at normal speed, stop F/2, and fast panchromatic film was used.

The surfaces of the wooden letters were painted with dead black paint as otherwise they would not have shown up against the white background.

Some form of decoration seems appropriate for the subtitles on a Christmas film, so several designs are suggested. These were copied or adapted from last year's crop of Christmas cards. Use one of these or work out one for yourself, but stick to just one design for all subtitles.

EASY METHOD OF SHARPENING LARGE DRILLS IN A LATHE

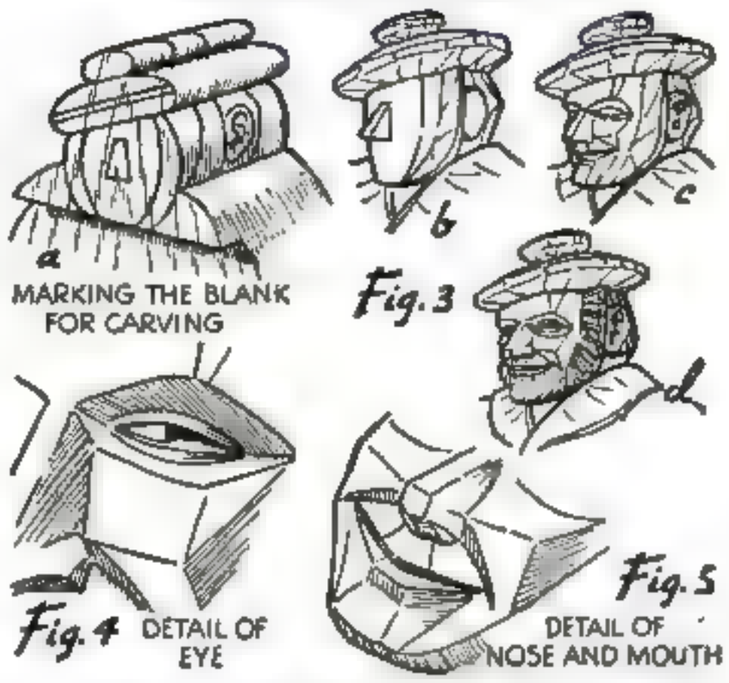
In the absence of proper drill-sharpening equipment, I have found it a comparatively simple job to sharpen large twist drills by hand in the lathe by the following method: First grind off a rear corner of one lip sufficiently to distinguish between the two lips—just an identifying mark. Then chuck a piece of cold-rolled stock, put the drill in the tailstock drill chuck, and feed it into the metal so you can note which lip is producing the most chips. Slide the tailstock back, and turn the heavier cutting lip to a convenient position for whetting. Carborundum of a coarse grade may then be used to stone down the offending edge. Start at the rear of the lip and work forward, and feed the drill into the stock occasionally to test. When both lips cut evenly, a touch-up with a fine stone will make the edge last longer and cut faster. If it is difficult during the sharpening operation to tell just where the stone is cutting, coat the surface of the lips of the drill with a saturated solution of copper sulphate.—Mark A. Cooper.

HOW TO REMOVE PENCIL MARKS FROM UNFINISHED FURNITURE

A pencil guide line or dimension mark on wood, which stubbornly resists removal by sanding or erasure, will disappear like magic if it is first moistened with clean water and then given a few strokes with a fine grade of sandpaper.—Eric Munsinger.

GASPARD THE SAILOR

(Continued from page 68)



Steps in whittling the head, and larger details of the cuts for eyes, nose, and mouth

ing the head, decide whether you want a Breton, a Scot, or merely an overweight sailor of any nationality. Sketch in the lines of Fig. 3a and cut away the shaded portions and shape the pompon. Round up his tam and cut the concave curve of the tam toward his head all around. Sketch on his whiskers in any way you want them; then cut away the waste wood just as you did in shaping his arms. Draw his nose as in Fig. 3a. Cut back the plane of the face all around it until it stands out prominently, but remember to leave the ear blanks behind the mutton-chop whiskers. The head should now resemble Fig. 3b.

Round up the plane of the face, divide it into thirds horizontally, and cut deep notches for the eyes and mouth. The top line of the eye notch—the eyebrows—should come even with the top of the bridge of the nose, and the top line of the lower notches (one at each side of the nose) should come just above the nostril on each side, as clearly shown in the side-view photograph.

Cut the bottom of the nose as in Fig. 5, and about a third of the way from nose to chin, sketch and cut the crescent-shaped groove that marks the mouth. Form the upper lip by cutting straight upward from this groove to the bottom of the nose, sloping the surface backward and upward until it meets the upper wall of the original triangular notch, as indicated in Fig. 5. The lower lip protrudes slightly, so round up the lip itself and cut away a little wood beneath it all along. Shape the chin by cutting away the outer, lower edges of the triangle, and finish the mouth as indicated in Fig. 5.

At the bottom of each eye notch, round up an eyeball-shaped mound, divide it in two horizontally with a grooved line, and cut a deep triangular wedge out of one half of the lower portion, as in Fig. 4. Be sure the wedges are cut from the same side of each eye. The head will now look like Fig. 3c. Cut a series of V-notches side by side along the beard, shape up the back of the head and groove it similarly, and cut a triangular notch to represent the passages in the ear (Fig. 3d).

Sketch in the neckerchief, outline it with a V-groove all around, and cut away the blouse beneath it. Make several rough cuts along the sleeves to represent wrinkles, and one or two on the blouse. Three notches on each arm, as shown in Fig. 1, radiate from the inner edge of Gaspard's elbow to represent wrinkles.

If you want to paint the figure, you can make the pants and tam white, the blouse and pompon dark gray or blue, the neckerchief red with white polka dots, and the shoes black. Touch up the face and hair as you wish, and Gaspard is finished.

To change Gaspard's size, use larger or smaller squares when drawing the checkerboard.

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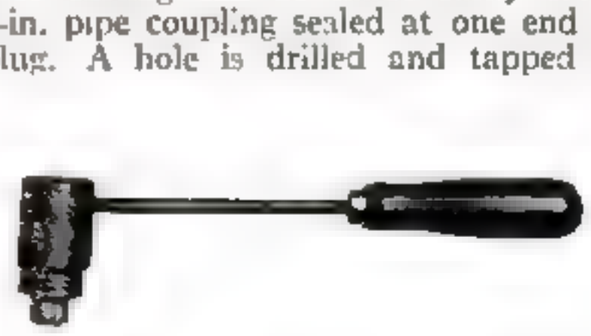
SMALL SOLDERING LADLE MADE FROM COUPLING

A SMALL solder-melting pot for dipping or casting can be made easily from a 1¼-in. pipe coupling sealed at one end with a plug. A hole is drilled and tapped near



This improvised solder-melting pot has the advantage of retaining heat for some time

the other end, into which a short piece of iron rod is threaded. An ordinary file handle is squeezed on the end of the handle.

When heated over a blowtorch or a gas jet, this pot holds the heat for some time. If required, a small file cut may be made in the lip to facilitate more accurate pouring with the ladle.—WALTER K. Moss.

FIRST STEPS IN INSIDE PAINTING

(Continued from page 76)

By avoiding powders containing true soaps, we must have recourse to the safer washing powders that have trisodium phosphate as a base—generally about 75 percent with 15 percent sodium metasilicate, 10 percent sodium borate, and sometimes further modified to use some soda ash. All of these have various functions in loosening the film of dirt.

If, however, we are to use the new paste cleaner mentioned before, the dry powder should be stirred into a 12-qt. pail partly filled with cold water. When the paste has thickened to a body that does not quite drip from a wall brush, it is about right for use. It is applied as shown in one of the illustrations by using any old, wide wall or paintbrush, or a new one if need be. Do not leave the brush standing in the paste, or leave the paste in the brush overnight.

START at the bottom of a wall panel rather than at the top. I know that some of my painting friends have spent a lifetime doing just the opposite, but painters have wondered for a long time why a few spots and streaks would appear on their work after the wall had been dried, following a really fine job of washing. I undertook to study this out and found that when the washing was started at the top, some cleaning compound always spotted or dribbled down the wall below. By marking the location of these spots and letting the washing continue to completion, it was discovered that these same spots or dribbles were the ones that appeared to be a different color on a perfectly clean wall after it had dried. Study of the spots showed that the cleaner dried enough, before being subsequently washed off in the cleaning process, to become quite concentrated and hence "bit in," as the painters call it, much more than the normal material. When a wall is washed from the bottom up, any spatters of the cleanser fall on the freshly washed wall below, where there is no dirt to accompany the "biting in," hence no spotting.

Another aid in cleaning is a new type of cellulose sponge—a yellow, rubberlike material that will do practically all the natural sponge can and some things that it cannot. The artificial sponge is manufactured in a number of cut shapes and sizes. Being square faced, it makes better contact, does not tend to bend away from the surface, and best of all, does not drip, even when used on a ceiling.

Throughout the washing process the floors should be protected with adequate drop cloths, cloth strips, or both, and, when necessary, with a layer of building paper beneath. The feet of ladders and stools should be examined to see that nothing adheres to them to mar polished floors.

It is during the cleaning process that all repairs, sanding, puttying, and resanding must be done, previous to the work of undercoating or enameling or both. In many cases the use of several grades of waterproof or so-called "wet-or-dry" sandpapers will do much to expedite the work. One of the illustrations shows a column being wet sanded. Since this column is part of an open-arch treatment between a living room and dining room, to use dry-sanding methods would be certain to spread ivory enamel dust over the walnut dining-room furniture adjacent. With the wet sanding, dust is avoided. The work is afterwards sponged off with clear water and wiped with a washed chamois (wash leather), freshly squeezed free of water, so that it can be quickly and easily inspected.

When wash leathers are freshly bought, they are full of padding grease used to keep the leather soft and flexible during manufacture. Before such a skin can be used to wipe dry paint surfaces or to clean windows, it must be washed in tepid water and rubbed freely with a mild, white soap. If no clothes wringer is at hand for drying the leather, it must be folded into a pad and squeezed dry, not wrung.

FOR all work of this nature, a low (12-in.) and a high (18-in.) square stool with an 18-in. square top, are good. They aid in cleaning and painting jobs around the house, as illustrated in the center photograph at the beginning of this article.

After all the ceilings, walls and trim have been washed and rinsed, there still remains the floors. In actual practice these should simply be cleaned with a broom and wiped up, after which the well shaken drop cloths are relaid. Then the decoration of the ceiling and trim may be completed.

When every part has been inspected and passed, it is time to clean the floors. If they are varnished and have been cleaned with an oil mop during their use, it is very necessary that an alkali cleaner be used to remove all wax or oil films. The trisodium phosphate, soda-ash cleaners are excellent for this work. If a cupful of powder is dissolved in a 12-qt. pail of clean, warm water and applied freely to a small portion of the floor, rubbed around with a brush, and then wiped up clean with a fresh sponge and clear water, a fine clean surface is left for revarnishing. However, let the washed floor dry overnight.

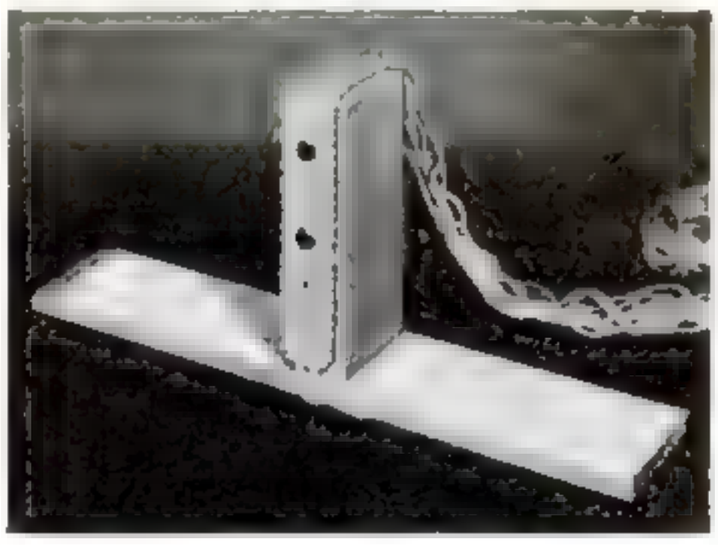
Do not clean a floor with gasoline or turpentine; they will only dissolve traces of wax and oil and spread them around over the surface so that when a coat of varnish is applied it is almost as certain to remain sticky and collect dust as did my friend's unfortunate job of enameling.

T-SHAPED HOLDER AIDS IN SQUARE-KNOT WORK

The base is placed under the legs with the upright between knees. Tacks hold the work

MUCH time may be saved in making square-knot belts and other types of knot work by using a holder of the kind illustrated. It is merely a piece of wood 2 by 3 by 7 in. fastened to the center of another piece ½ by 3 by 12 in. The finished end of the work in process should be fastened to the upright with thumb tacks, and it is moved back from time to time as the work grows in length.

To use the holder, sit with the base beneath the legs and the upright between the knees. Push the board as far forward as possible. The weight of the legs is sufficient to hold it in place, even when the work is given a strong tug.—WARREN H. BUELL.



Only two pieces of wood are needed to make the holder. Both should be well smoothed

LIGHT SHOE-TREES MADE FROM WIRE HANGERS

NOT wanting to add the weight and bulk of shoe-trees to my luggage on a recent trip, I improvised a pair by bending two wire clothes hangers as shown. They proved to be so useful and effective that I have discarded all others in their favor. They are easy to replace in case they become mislaid or lost, and can be hung on hooks to keep the shoes off the floor and out of the way.—K. F. KEITH.

The coat hangers are doubled over and the hook bent and locked with the bottom part

MAKING SOLDER STICK TO IRON

SOLDERING cast iron is difficult, but may be done by copperplating it before soldering. This is accomplished by rubbing the iron with wet copper sulphate (blue vitriol) crystals.

DRESSING TABLE WITH STOOL AND MIRROR

(Continued from page 74)

runs. The proper assembly is shown in Fig. 4. Be sure to have them all square with the frame.

The drawers come next. The small drawer, shown in Fig. 5, is for pins, safety pins, hairpins, and the like. It is quite shallow and has small receptacles built into it for the purpose. Anyone who has made drawers before will have little difficulty in making the large drawers. The drawer fronts are molded and protrude ¼ in. from the frame.

When all the drawers have been fitted, glue up the top and fasten it to the frame. This may be done with regular table-top fasteners or by fastening it to narrow strips screwed to the inside of the frame.

A detail of the carved shell is shown in Fig. 8. If the legs are to be carved, the work should, of course, be done before assembling the frame.

Be careful in choosing the hardware for this piece, because nothing will so mar the appearance as inappropriate hardware. Bail handles, similar to those shown, are the only proper kind to use. These may be purchased in a dull antique color.

In making the stool (Figs. 9 to 13), the legs are shaped from solid stock in the same manner explained for the table. The stretchers may be of hard pine since they will be covered.

To upholster the stool, tack webbing to the underside of the stretchers, two strips lengthwise and three crosswise. Interweave these as shown in Fig. 12. Sew six 6-in. seat springs where the webbing crosses and tie them with heavy twine. For best results they should be tied four ways. Do not compress the springs much when tying *(Continued on page 108)*

List of Materials

QUEEN ANNE DRESSING TABLE

No. of Pieces	Description	T.	W.	L.
4	Legs	3	3	29⅛
8	Block to glue to legs	3	3	3
1	Back	⅞	10½	30
1	Front apron	⅞	6¾	31½
2	Ends	⅞	10½	15½
1	Rail above large drawer	¾	2	31
1	Top	⅞	20½	38
1	Large drawer front	⅞	3	29
2	Small drawer fronts	⅞	3½	8
1	Pin-drawer front	⅞	1¼	9
2	Drawer sides (poplar)	½	3	17½
4	Drawer sides (poplar)	½	3½	17½
2	Drawer sides (poplar)	½	1¼	17½
1	Upper drawer back (poplar)	⅜	2½	28½
2	Drawer backs (poplar)	⅜	3	7½
1	Drawer back (poplar)	⅜	⅞	8½
1	Drawer bottom (plywood)	¼	17¼	28½
2	Drawer bottoms (plywood)	¼	7½	17¼
1	Drawer bottom (plywood)	¼	8½	17¼
2	Partitions for pin drawer (poplar)	⅜	⅞	8½
6	Partitions for pin drawer (poplar)	⅜	⅞	3¾
4	Drawer runs	¾	1⅝	16¼
4	Drawer runs	⅜	1¼	16¼
4	Drawer guides	¾	1⅛	14½
	Small blocks to support drawer runs (see drawing)			

QUEEN ANNE STOOL

4	Legs	2¾	2¾	16
8	Blocks to glue to legs	2	2	2¾
2	Long stretchers	⅞	3	22½
2	Short stretchers	⅞	3	12½
	Corner blocks (to fit)			

MIRROR FRAME

1	Molding	¾	1½	80
1	Top	⅜	4¾	13½
1	Back (plywood)	3/16	15	23
	Splines (see drawing)			

NOTE: Dimensions are given in inches and are, as far as practical, the finished sizes.

DRESSING TABLE WITH STOOL AND MIRROR

(Continued from page 107)

them and see that the tension is kept even.

Cover the springs with burlap. On top of this spread a thick layer of moss or curled hair. The latter is better but more expensive. Sew this to the burlap with loose loops. Cover the moss or hair with muslin, being careful to pad it evenly beneath the muslin and leave no lumps. A thin layer of cotton felt under the muslin will help to secure a smooth seat. Cut the cover and nail it in place with upholstering nails. It is a good idea to sew the cover at the corners. A piece of fine silk brocade or a cheaper material may be used.

For the mirror frame (Fig. 14), make a long piece of molding ¾ in. thick by 1½ in. wide and long enough to cut all four sides. This molding may be carved by hand, and places for each corner must be left unfinished until after the frame has been assembled. After mitering the pieces, lay them on a flat surface and make rubbed glue joints. Glue pieces of heavy wrapping paper to the top of the joints to help hold them in place.

When the glue has dried, turn the frame on its face and screw a thin plywood board to the back of the frame to make it rigid. This may later be used to cover the back of the mirror, but its present purpose is to prevent the frame from coming apart at the joints while cutting the grooves for the splines. These grooves may be cut on the circular saw or with a hand saw. When the splines have been glued into place, cut small corner blocks and glue them to the inside of each corner to furnish stock to round the inside corners. Shape the inside and outside corners and finish carving the frame at the joints.

Next make the top of the frame and fasten it with small, thin blocks as shown. Put in the mirror and cover it in back with the thin plywood

A stain suitable to the wood should be applied, and a rubbed varnish finish should be used to complete the three pieces of furniture.—FRANKLIN H. GOTTSHALL.

For detailed instructions on staining, varnishing, and rubbing furniture, see P. S. M., June '36, p. 64; July, p. 64; Aug., p. 66; and Sept., p. 75.

MAGAZINE RACK AND WASTE-PAPER BASKET

(Continued from page 75)

a spring or sweep of approximately ¾ in.

The preferred method of joining the sides of the wastebasket is indicated in detail *A*—a miter joint having a continuous spline, which is easily made on the circular saw. If this machine is not available or if you prefer the additional security of screws, use the joint *C*, making one groove in each side of the wastebasket.—DONALD A. PRICE.

List of Materials

MAGAZINE RACK

No. of Pieces	Description	T	W	L
1	Base	¾	15½	13¾
2	Sides	⅝	13¼	12
1	Back	⅜	12	14½
1	Middle partition	¾	8	14½
1	Handle partition	⅜	10	14½
1	Front	⅝	2½	14½
4	Feet	¾	3	3

WASTEBASKET

4	Sides	⅛	13	15½
1	Bottom	¼	10¼	10¼
4	Cover strips	¼	¾	11½
4	Feet	¾	3	3

NOTE: All dimensions are given in inches.

BUCKLES AND BUTTONS MADE OF HARDWOOD

(Continued from page 79)

Band-sawing a blank for making a buckle. It is about 5/16 in. thick and slightly curved

hook are cut and glued to the face of the buckle. Two small dowels add to the strength. The ends of the buckle on which the belt material is to be fastened are cut out with a jig saw between two ¼-in. holes drilled ⅜ in from the ends and the same distance from the top and bottom as in Figs. 3 and 4. The yoke in Fig. 2 is cut out with a jig saw, and pieces of 3/16-in. dowels are glued into the holes at the top and bottom of the buckle.

Initials or designs may be cut from thin pieces of wood and glued to the buckle with waterproof glue, or cut through the buckle, as in Fig. 3, with a jig saw. If glued on, they should be carefully sanded after the glue has dried to give them the appearance of being carved.

Buttons may be made in several different shapes, but the triangular or futuristic is probably the simplest and most effective. A piece of wood 12 in or more in length is finished to ½-in square and placed in a V-grooved jig (Fig. 5). This jig is merely a 6-in. square piece of scrap wood with a 90-deg. groove cut across the face parallel to one edge. One corner is cut off on a 45-deg. angle across the groove, and the cuts are made along this angle of the jig. Turn the stock 180 deg. for each cut. The length of the button may be as desired. Sand the ends carefully and cut a half-round notch in the back of each button with a rat-tail file. In the bottom of this notch, at the center, place a small screw eye (Fig. 6).

Suggestions for two other button designs are given in Fig. 7. The life-preserver type may also be used as an ornament for a nautical buckle. This button is turned on a lathe, and the four segments are carved or scribed with a sharp knife.

Sand all buckles and buttons with very fine sandpaper and apply a few coats of clear lacquer to preserve the natural texture of the wood.—ARNOLD S. LUTES.

NOTICES OF MEETINGS PRINTED WITH STENCIL AND INK PAD

TO MAKE a rough stenciling outfit for printing club notices or other form messages on post cards and the like, simply typewrite your notice on a piece of ordinary stencil wax, obtainable at a stationery store. As in all stenciling, remove the typewriter ribbon so as to cut the message with the bare type. Then, using a common rubber-stamp ink pad, place the stenciled notice against the pad, with the face side down, smooth out the surface of the wax, and wrap the loose edges of the sheet around the back of the pad in order to hold the wax firmly. Pick up the pad and stamp the message as you would handle an ordinary rubber stamp. A little practice will show how hard to strike for an impression, because too much pressure will make the notice difficult to read.—CHESTER L. SHAW.

EQUIP YOUR MICROSCOPE FOR POLARIZED LIGHT

(Continued from page 53)

fine crystals dispersed through a transparent material. Light can vibrate only parallel to the crystals in passing through.

The material is mounted between pieces of glass for protection, and these simple glass squares or disks are placed below the microscope stage and usually above the eyepiece, much as if they were Nicol prisms. You can purchase the polarizing plates in various sizes, up to nearly two inches in diameter, for ten dollars a pair; and you can obtain them especially mounted for microscope use, at the same price. The larger, unmounted form may be preferable to the microscope type because the polarizing plates can be used for other purposes, such as elimination of reflections in photography, and in the projection of images of objects by polarized light with a lantern or low-power projection microscope. Plans are being made to offer an amateur-size polarizing set that will sell for a fraction of the cost of present equipment.

A microscope fitted with a special polarizing eyepiece attachment. This instrument also has a revolving stage, which is useful for studying minerals and can be attached to many microscopes of the amateur type

Simple and inexpensive polarizing attachments of remarkable efficiency can be made from nothing more than two dozen or so clean cover glasses and a quantity of glue and cardboard tubing. It happens that a ray of light passing through a sheet of glass at an angle of about thirty-three degrees to its surface is polarized, one beam passing through the glass and the other being reflected from its surface at right angles to the first. The polarizing effect with a single sheet of glass is not complete; but when several pieces are placed together, almost complete polarization can be produced.

SO, TO make a simple polarizer and analyzer, you merely mount two stacks of cover glasses so that they are at an angle of about thirty-three degrees to the axis of the microscope lenses, and arrange one of the units so that it can be rotated. From eight to twelve cover glasses will be sufficient for each unit. Clean the glasses well with a household cleanser. Make from cardboard, rolled paper, or (if you have a lathe) brass, two tubular housings for the glass pieces. One of these is to be mounted directly under the hole in the microscope stage if there is room, or somewhere in the beam of light falling on the substage mirror if there is not. The analyzer housing can be made so that it will fit inside the microscope tube directly below the eyepiece, or so that it will slip over the eyepiece; or the cover glasses can be mounted inside the eyepiece, just below the upper lens. The exact form of the housings will depend on the microscope you have.

If you use square cover glasses, the cardboard housings can be rectangular in section. For round housings, oval-shaped glasses are best. Make the *(Continued on page 111)*

EQUIP YOUR MICROSCOPE FOR POLARIZED LIGHT

(Continued from page 110)

housing in two parts, consisting of an inner sleeve that fits snugly inside an outer sleeve. Remove the inner one and cut it in two along a line that makes an angle of thirty-three degrees with the axis. Cover one half of the inner sleeve with glue and slide it into the outer one, drop the cover glasses in place, and then glue the second half in place. The glasses should be tilted at the proper angle, and held securely in place. Paint the inside of each housing with black India ink, to kill reflection.

THERE is almost endless variety to the things you can examine by polarized light. You will find that some substances, such as sugar, do not affect the light ray as it passes between the two polarizing units. Therefore, when examined through crossed polarizers—that is, through units at right angles to each other with respect to their polarizing action—the entire microscope field appears dark. But introduce into such a field a double-refracting substance, such as a bit of cellulose, or a crystal of potassium chlorate, and you see the substance clearly—and often with surprising brilliancy and color—against a darkened background when the polarizers are crossed.

Now for a few excursions into the wonderland opened to your microscope by polarized light:

Cellulose, the common plant material, shows very brilliant polarization when the polarizing units are crossed. Examine some cotton fibers and a bit of lens tissue paper by ordinary and then by polarized light. The appearance of cellulose in polarized light often is used to identify it when it appears among other materials. Examine a section of plant stem by polarized light.

Scrape a bit of fresh-cut potato into a drop of water on a slide, add a cover glass, and examine the starch grains by ordinary illumination. Then look at the grains by polarized light. What a striking transformation! In each grain you see a little, dark cross. This cross is characteristic of starch, and enables scientific sleuths to identify starch when found among other substances that have similar appearance in ordinary light. Starch from different sources, such as tapioca, wheat, and potatoes, can be distinguished.

To examine human hair, obtain a white hair so that the pigment will not interfere. Cut it into short lengths, and mount it on a slide in balsam or water. Remove grease from the hair by washing it in benzine or carbon tetrachloride. In polarized light, the hair sections possess amazing beauty.

Look at the crumpled transparent wrapper from a package of cigarettes or chewing gum by polarized light. The colors produced are striking and beautiful. You can make such examination at the lowest power of your microscope—or, in fact, without any magnification at all.

THE structure of bone, as revealed by examination of thin slices, can be seen with increased clarity in polarized light. Bone sections suitable for the microscope are made by cutting a piece of beef bone or other bone as thin as possible with a saw, and then grinding the surfaces smooth on an abrasive stone lubricated with water. The section is held while the second surface is being polished, by mounting it on a glass slide with hot balsam. Use a fine razor hone for the final polish.

Of the hundreds of crystalline materials that appear with remarkable beauty in polarized light, few are more awe-inspiring than potassium chlorate. Obtain some of this salt from a drug store—you will need only a pinch—and dissolve it in a few drops of warm water. Put some of the *(Continued on page 112)*

EQUIP YOUR MICROSCOPE FOR POLARIZED LIGHT

(Continued from page 111)

water on a slide, spread it out in a thin layer, and let it dry. Many small crystals will form. Examined with ordinary light, the crystals are all of one color, and only moderately distinct as to structure. But when you look at them with the polarizers, you find yourself gazing upon a collection of jewels more gorgeous than any that ever filled a royal treasure chest. Each tiny crystal blazes forth in startling color, and it seems as if each crystal has its own peculiar hue. In fact, many of them exhibit several different colors at once. Rotate one of the polarizing units slowly, and you see this chemical jewel box undergo a complete color transformation. The crystals, when perfectly dry, can be mounted under a cover glass in balsam. Many common crystalline substances afford materials for striking polarization studies.

CERTAIN minerals, when obtainable in properly prepared sections, are very beautiful in polarized light. In fact, it is with the polarizing microscope that science has unearthed many of the secrets of the mineral world. Thin sections are made by grinding pieces on abrasive stones, in a manner similar to that employed for bone. Among the better minerals for the purpose are granite, marble, asbestos, selenite of various thicknesses, agate, and quartz felsite.

Among animal substances, in addition to bone, you will find it worth while to examine sections of hoofs of horses or other animals, and sections of horns of oxen or sheep; quills from feathers, fish scales, raw silk, and wing cases of various beetles also make interesting subjects.

One of the most valuable properties of polarized light is its power to reveal the lines of strain produced in glass, celluloid, and other transparent materials. It is generally known that glass may be under a strain because of pressure or uneven cooling, but unless polarized light is available the regions of strain cannot be seen.

Sometimes a microscope slide that has not been annealed properly will cause trouble when used with the polarizer. To deliberately create strain in a slide, heat it carefully so that it becomes red-hot in one spot, and then allow it to cool. When examined by polarized light, the lines of strain set up by the heating and cooling are clearly visible. In a similar way, you can see the strains produced in a glass slide by pressing against the edge with your finger nail!

PRINCE RUPERT drops show in beautiful colors and lines the presence of strain. These drops can be made by heating a thin strand of glass, drawn from a piece of tubing or rod, with a blowtorch and letting the drops of molten glass fall into a tumbler of water. Most of them will break into small fragments when they plunge into the water, but a few will come through unbroken. These few are subjected to tremendous stresses by the sudden cooling, and examination with the polarized light will show the resulting strain. Be careful in handling the Prince Rupert drops, because they have a way of exploding at the most unexpected moments. Keeping them in a glass phial is safest, and they can be examined without removal.

You may find it interesting to cut out little celluloid models of bridges and other objects and see how the strains are distributed when they are placed under load. Transparent celluloid shows areas of strain clearly in polarized light. Because of this fact, engineers have learned much about building skyscrapers and bridges by actually watching the behavior of celluloid beams and columns under various loads.

COFFEEPOT STEAMS OFF OLD WALL PAPER

TO SAVE time in removing four thicknesses of wall paper from our upstairs hall in preparation for repapering, my wife suggested that I make the steam-electric wallpaper remover described a short time before in POPULAR SCIENCE MONTHLY (Apr. '36, p. 59). I would have done this but for the fact our nearest source of supply for heating coils is twenty miles away, so I devised a substitute from a small electric percolator.

The basket that holds the coffee was removed, as well as the top. Water was poured in until it reached halfway up the inside opening of the spout; and a rubber disk, a little larger than the cover opening of the pot, was cut from an old inner tube and placed in this opening. A glass preserve jar top was then forced down on the disk and held with a loop of wire passing under the pot. A bath spray nozzle with a rubber rim was then stuck in the end of the spout and fastened with friction tape.

A loop of wire holds down the percolator top so all of the steam goes through the nozzle

The steamer was used in the way illustrated. As soon as the steam stopped coming out of the spout, the cover was removed and more water added. The results were excellent, as the paper came off completely and quickly. After all the old paper had been removed, it took only a few minutes to reassemble the coffeepot and put the shower bath spray back in service.—EDWARD B. FOX.

WELDING TOOLS KEPT IN PLACE ON PANEL

MOST welders will appreciate the advantages of this tool panel, made from sheet metal, which can be secured to the wall of the shop with two nails, screws, or bolts. All the fixtures are welded on. Two hooks extend below the panel to support whichever torch and electrode are in use. Double pins hold wrenches; single pins, goggles and the lighter. A sheet metal angle with different sized holes supports spare tips, while double pairs of tubing sections hold three kinds of rods. Loops made of small rods hold the shield and spare torches, and two loops make a retainer for a can of flux. The panel is especially handy on field jobs, keeping everything in order.—J. C.

The tool-holding fixtures are welded on

Secrets of Success

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Two prize winning letters in POPULAR SCIENCE MONTHLY'S new Secrets of Success contest—*"What Home Study Has Meant to Me"*—are printed below. Read these stories carefully because your own career may be just as interesting and inspiring to other readers. If you think so, put it down on paper and send it in. We will pay $5 for every letter we publish.

Contest Rules

Only letters from bonafide home study school students will be considered and these must contain the name of the school and the name of the company, or companies, for whom you have worked since graduation. (Names, however, will be deleted from the letters when published.) We also want to know the kind of course you took and the type of position you have held. Your own identity will be kept anonymous, if desired.

We are interested in facts, not literary ability, but please write clearly, completely, and keep your letter within 750 words. We are not looking for "get-rich-quick" stories or freak adventures, and authors must be prepared to substantiate the truth of the statements. Manuscripts submitted and printed become the property of this magazine, and we are not responsible for the return of rejected stories unless sufficient postage is provided for this purpose. Address your contribution to Success Story Department, Popular Science Monthly, 353 Fourth Avenue, New York, N. Y.

"CAN ALWAYS GET A JOB IF I NEED ONE"

A year and a half ago I was just one of the thousands of young men fresh out of high school or college waiting for a call to work on the WPA or any other job that I might find.

I was interested in mechanical engineering but to gain employment in that field one must have theoretical and practical training. Because the cost of a college education was too great for me, the correspondence school was the only means of obtaining the proper instruction.

I enrolled with the ——— School in Chicago taking their Diesel engineering course. Later, another school offering home study in Diesel engineering attracted my attention because it afforded an opportunity to obtain practical experience in one of their many shops after completing the home study work. Consequently I enrolled with them, too, and when I finished the course I had three weeks on the engines in their Long Island school shops.

I did not wait for the school to find me a job. I went out after it myself and a week later, with the aid of a Y.M.C.A. employment service, I was signed as a

★ Perhaps it is fortunate that we do not always see ourselves as others see us. But when it comes to making progress in our work, in earning more money, facing the cold facts is courageous even though sometimes upsetting.

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Secrets of Success

wiper aboard the liner ——— on a South American run. After half a trip I was advanced to fireman due to my interest and knowledge of engineering and on the next trip I was advanced to topside oiler with a substantial increase in pay, moving ahead of men with longer sea experience because of the characteristic determination of home study men who go out and get their knowledge on their own.

If I remain on the ship I have the opportunity of getting a junior engineer's position within a year should I prove worthy of it and, in time, work into a licensed engineer's position.

In any event, I shall complete the first course I took, because it is more technical and includes the necessary information for a designing engineer or anyone interested in construction and design in the Diesel field. And now that I have a number of (very good) Department of Commerce ship Certificates of Discharge I feel that I can always get a job if I need one.

Home study has gained for me economic independence and confidence in myself, and since self-confidence is an essential of success, I feel certain that in time I shall find myself a position in the particular branch of the field in which I am most interested.

There are more courses which I intend to take because I believe that home study prepares us to enjoy life to the fullest measure. We can take courses in avocational as well as vocational fields.

Every day existence becomes more and more complexed with the technological advance of industry, commerce and government, but the determined person, with increasing periods of leisure, has at hand a treasure house of knowledge and opportunity through the medium of home study. And this, to me, is the best cure for bad nerves and insecurity there is on earth.

—*I.H.H., New York, N. Y.*

AT 30, SUPERINTENDENT OF WATER-LIGHT DEPT.

A few weeks before the midterm examinations of my senior year in high school, my mother left our home in southern Oklahoma to visit a sister in Kansas. Shortly after her arrival there, she became critically ill and I was called to her bedside. Later I returned to Oklahoma and took the midterm exams, making arrangements to complete the rest of the school term by correspondence. Thus began my experience with home study . . . at the age of 16.

My mother was a patient in a Wichita sanitorium for seven months, so I stayed on until the end of the school year when I returned to Oklahoma and graduated with the other pupils with whom I had studied for so many years.

Back again in Wichita, I took up the study of electricity through a correspondence course offered by the ——— Schools of Chicago, and upon my mother's release from the hospital we came to Protection where I continued my studies and did part-time work for the municipal wa-

Secrets of Success

ter and light department and the telephone company. Later on I became a regular employe at the light plant as night engineer.

This job offered an excellent opportunity for advancement in home study work as well as practical experience, so I continued my studies of electricity through ———'s Library and other books and periodicals.

All this time I had a longing to learn something about woodworking and chemistry, but since neither of the subjects were taught in the high school I had attended it appeared that these, too, would have to be studied at home, if at all. However, I felt that chemistry was not a subject that could be taught to the best advantage by correspondence so I enrolled in the local high school at the age of 20 for post graduate work in physics with the intention of taking up chemistry the next year. But I had waited too long. My age was against me and the school refused to enroll me the second year.

It did not stop me, though. While in high school, my physics teacher had me use POPULAR SCIENCE MONTHLY as an auxiliary text. Since this magazine had considerable space devoted to various hobbies including chemistry and wood working, I decided to use it to further my education along these lines. I started to assemble a home workshop and through practical experience and the help of a number of publications, I have been able to learn the rudiments of these two subjects.

During the depression, when salaries were being cut often and deep, I found that my home workshop enabled me to make both ends meet even though I had added to my financial burden by marrying and raising a family. Nine months ago I was advanced in my position with the water and light department to the position of superintendent.

My experience has not been meteoric but after fourteen years of home study I find that one can learn much and advance in knowledge without going to school in the conventional manner.

—*R.C.C., Protection, Kansas*

OVERCOAT MAKES HANDY PORTABLE DARKROOM

When no darkroom is available, an old and heavy black overcoat may be used for switching films and loading developing tanks. Simply run your hands through the coat sleeves in the wrong direction, and fold and tuck the sides and tails of the coat over and underneath, after placing the photographic equipment to be used inside. This forms a miniature darkroom that gives perfect freedom of the hands. After a little practice, films can be wound on developing-tank spools or changed from camera to camera as easily as in broad daylight. This latter stunt comes in handy when checking shot for shot between two cameras using the same size film. With the film and the scene remaining constant, any discrepancies of focus or light intensity can be traced down, providing one camera is known to be correct.—Wallace H. McClay.

Measuring Temperatures

IN A WORKSHOP FURNACE

W. C. CHENEY tells how to make a pyrometer and gives hints on tempering

An inexpensive millivoltmeter calibrated so as to give reading of pyrometer immediately in degrees Fahrenheit

GUESSWORK in the use of a furnace for hardening and tempering steel can be eliminated by means of a pyrometer, which is nothing more than an instrument for measuring heat beyond the range of an ordinary thermometer. In industrial plants and large shops, pyrometers are, of course, standard equipment, but many small shops still depend upon hit-and-miss methods of determining furnace temperatures. This is unnecessary because a serviceable instrument can be assembled at relatively small cost.

The pyrometer illustrated was designed for a furnace described previously (P. S. M., July '36, p. 86; see also June '36, p. 84). It would be an equally valuable accessory for any similar type of heat-treating furnace.

The sensitive element of the pyrometer is made of two dissimilar metals that will withstand high temperatures and generate an electric current when heated. There are a number of these alloys, and they may be obtained from various instrument companies for a few cents, or the complete element with lead wires attached can be bought for approximately three dollars.

Lay the alloy wires side by side and weld together at one end with the acetylene torch. Twist them and weld copper wire leads to the two open ends. Into one end of a ½-in. black iron pipe about 10 in. long, insert a porcelain tube such as is used in house wiring. The tube may be ground to size on an ordinary wheel if too large. Insulate the alloy wires and the lead wires with thin sheet asbestos. If the element is a homemade one, the lead wires should not be over 2 ft. long.

The lead wires are connected directly to a millivoltmeter, but as the element has polarity the same as a battery, the leads may have to be switched. This can be found by trial. When the element is used in the furnace, care should be taken to see that the alloy wires do not come in contact with the object being heated.

Because the current generated by the element is proportional to the heat applied, all that is necessary to obtain the temperature reading is to melt several metals of known melting points and use these temperatures to lay out the scale on the meter.

The meter may be any millivoltmeter, obtainable at a radio service shop or from a mail-order radio supply store for a few dollars. The percentage of error in the cheaper instruments is not sufficient to cause difficulty so there is no object in buying an expensive one. The meter illustrated was purchased for $1.50 and the error, when checked by eye with a $30 instrument, could not be noticed.

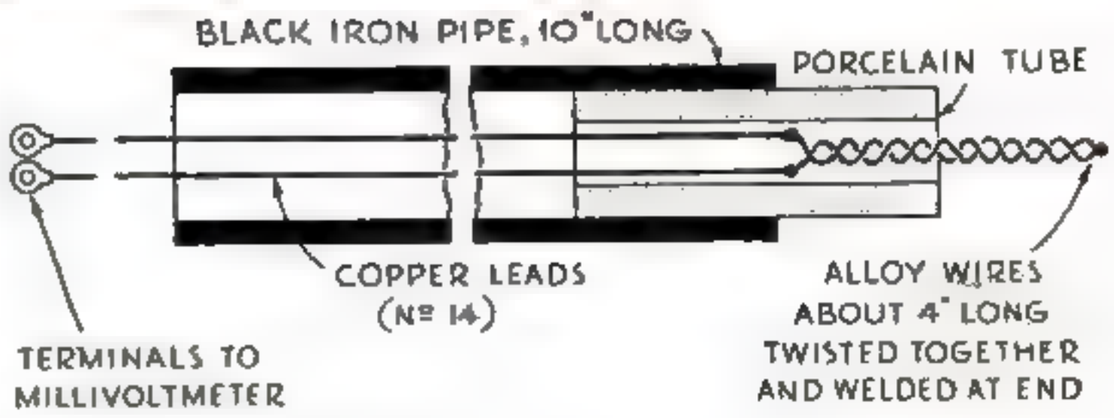
Remove the cover glass and glue a piece of white paper to the meter's face. Take various temperatures and mark each reading on the paper with a pin prick. Average the temperatures and distances of pointer travel, and step off the scale with a pair of dividers. In the particular case described, the pointer moved approximately ¼ in. for each 150 deg. of temperature rise. The scale was laid off from 0 to 1,800 deg. and when checked with a standard instrument, showed only a 2-percent error.

To obtain these temperatures begin with the furnace cold. Place a pan of water inside and start the torch. Bring the heat up slowly until the water just starts to boil. Place the element in the water and take the first reading on the dial, which will correspond to 212 deg. F. at sea level. Next take a piece of brick and hollow it out. In the hollow place a small quantity of zinc, put the element close to the metal, and raise the temperature until the zinc melts, which will give the reading for 788 deg. Do the same with a piece of aluminum, and the reading will be for 1,220 deg. Average the temperatures and swing of the pointer in order to extend the readings to 1,800 deg.

Once the pyrometer has been calibrated, the furnace can be adjusted to hold any required temperature. Information on heat treating steel, the use of baths for drawing temper, and tables showing tempering data for various tools can be found in standard shop handbooks. For the purposes of this article it will be sufficient to describe one of the simplest possible ways of tempering two common types of tools—cold chisels and wood chisels.

Chisels must be made of steel which is hard, fine-grained, and tough. To obtain maximum fine grain with maximum hardness, the steel must be quenched at just the right temperature, which for the average run of shop tool steel is between 1,450 and 1,500 deg. F. This gives the finest grain, but the tool is too hard for practical use, so some of the hardness is withdrawn by tempering — applying

The pyrometer element as it is placed in the furnace, and, at right, a diagram showing the method of construction. The alloy wires, which are the sensitive part of the instrument, are bought ready for use



a low heat gradually and again quenching at the proper moment.

Cold chisels, after the first quenching, should be scraped or ground bright. Place in the furnace, leaving the door open, and have at least one third of the cutting edge in the open. In a few minutes colors will appear and slowly travel toward the edge. When the edge is a dark purple, quench the tool in cold water. Instead of watching the colors, one may try the edge with a sharp file and quench when the file starts to take hold or cut.

The same procedure is used for wood chisels except that the tool is quenched at a dark straw color

If a large number of similar articles are to be treated, the best way is to harden them and then cool the furnace to the proper temperature, found by trial, and note the reading on the pyrometer, setting the burner to hold that heat. Extreme care should be taken in tempering or the tools will not stand up.

Some points worth remembering are:

If in doubt about a piece of steel, harden a sample first.

When practical, obtain the temperature data of the steel from the maker.

Never leave the shank of a chisel hard. Not only will it spoil the head of the hammer, but it is apt to chip and drive splinters into your hands and eyes.

When quenching a tool, plunge it straight down in clean cold water and hold it in one position until it is cold. Don't move it around.

If you overheat a piece of steel, don't cool to the critical temperature and then quench. Allow the steel to cool slowly in sand or slaked lime and when cold, reheat to proper temperature.

If you wish to cool a piece of tool steel without hardening, quench in soapy water.

If you want the tool very hard, quench in a saturated solution of salt water; for extreme hardness, quench in soldering acid.

OLD FUSES AID IN TESTING ELECTRICAL CIRCUITS

For the service man who is called upon to measure current in electric circuits, a handy addition to his test equipment is a set of leads for ammeters and wattmeters, made by soldering or clamping extra flexible test leads to the metal ferrules of dead cartridge fuses. With these leads an ammeter or wattmeter may quickly be inserted into a circuit by opening the circuit switch, removing a fuse, and inserting the dead fuse, across the terminals of which the testing instrument is connected. One or more sets for each size cartridge fuse may be made, thus enabling the test man to quickly tap in on any type of circuit.—Louis N. Goodman.

THIN WIRE GUIDES MERCURY DOWN BAROMETER TUBE

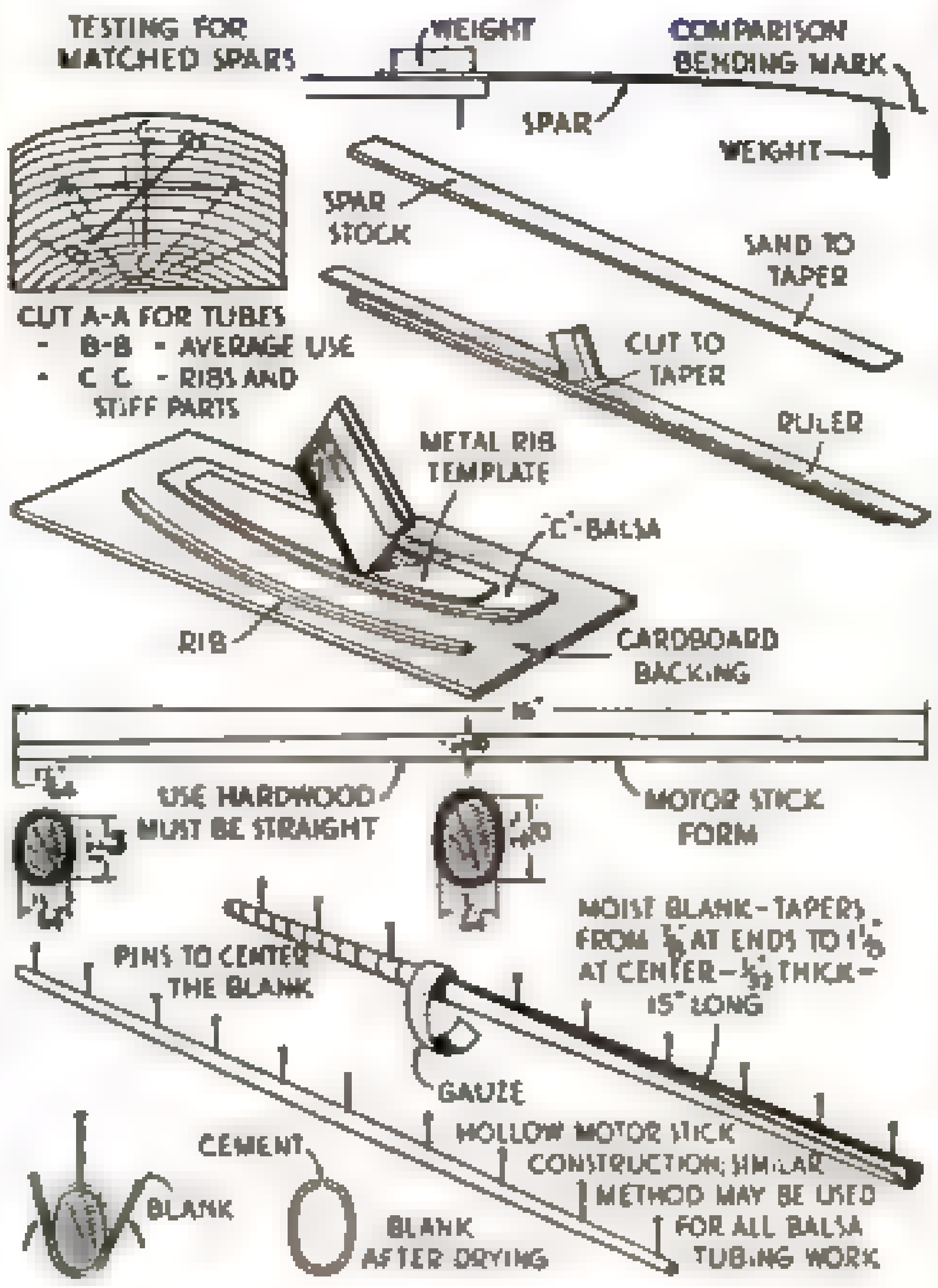
In building the mercury barometer described in a previous issue (P. S. M., Apr. '35, p. 64), I was at my wits' end to discover means of filling the barometer tube, which has a bore of only 1/16-in. diameter. The difficulty was overcome by placing in the barometer a fine copper wire long enough to reach the bottom of the tube. When the mercury was poured down the tube, the wire held it away from the glass enough so that the trapped air could escape. This greatly speeded up the filling.—Gerald McKelvey.

SOAPY WATER GIVES BETTER FINISH ON SOFT METALS

To machine copper or aluminum, either by hand or with power tools, and obtain a fine finish without roughening or pulling the metal, keep the part being machined wet with soapy water. If working on a machine that the soapy water might rust, use Diesel stove oil. Although the oil will help, it will not produce as good a finish as the soap water will.

INDOOR PLANE MODEL

(Continued from page 73)



How to select, cut, and test balsa, and methods of making a tapered tubular motor stick

will do. Bend slightly more than required to allow for the comeback. For irregular curves a cardboard form is used. Pin one end of the strip to it and, while keeping a steady tension, roll the strip around the form. Pin the free end, and hold the assembly over heat until the balsa has dried. Use tapered joints when cementing tips to spars.

The wing is made in two sections to facilitate covering with microfilm. One section is raised on end to the proper dihedral dimension while the center ribs are cemented. Place temporary corner braces as shown to keep the ribs in place while covering. The braces are removed after the two halves are joined.

A well-carved indoor propeller always surprises the uninitiated. A propeller having a diameter of from 15 to 16 in. is carved so thin that type can be read through it! Its weight is under .02 oz. The thickness tapers from 1/16 in. at the hub to 1/64 in. at the tip.

The wood used for propellers should be of 4-lb. grade and of even texture. Cut out the block and pierce the shaft hole with a drill press, or make yourself a squared hardwood block with a true center hole to serve as a drilling guide. The pin is guided in this hole while piercing the blank. Shape the block into an X-blank with about 3/32 in. thickness at the hub. Carve the concave side first. Be careful not to take too big cuts when approaching the pitch line, and also try to get an airfoil concavity instead of just any camber.

After the approximate shape is carved with the knife, finish the concave side with rough sandpaper and for final work use the 10/0 grade. The concave side should be completely finished so that the convex side can be carved to match it.

The outside can be carved with the knife until the blades are only 1/16 in. thick. Now cut one blade to outline shape, and make the other blade identical by transferring the outline on a paper template. From now on it is just a matter of patience until the prop is sanded to paper thickness. Try to have the hub about 1/16 in. thick and gradually taper the prop, to obtain a cantilever effect, to less than 1/64 in. at the tips. The sanding should be done with several grades of paper, each finer than the one before. Sand in one direction only. To insure even sanding, hold the blades on a broomstick or a quart-size bottle. As the blades get (Continued on page 121)

INDOOR PLANE MODEL

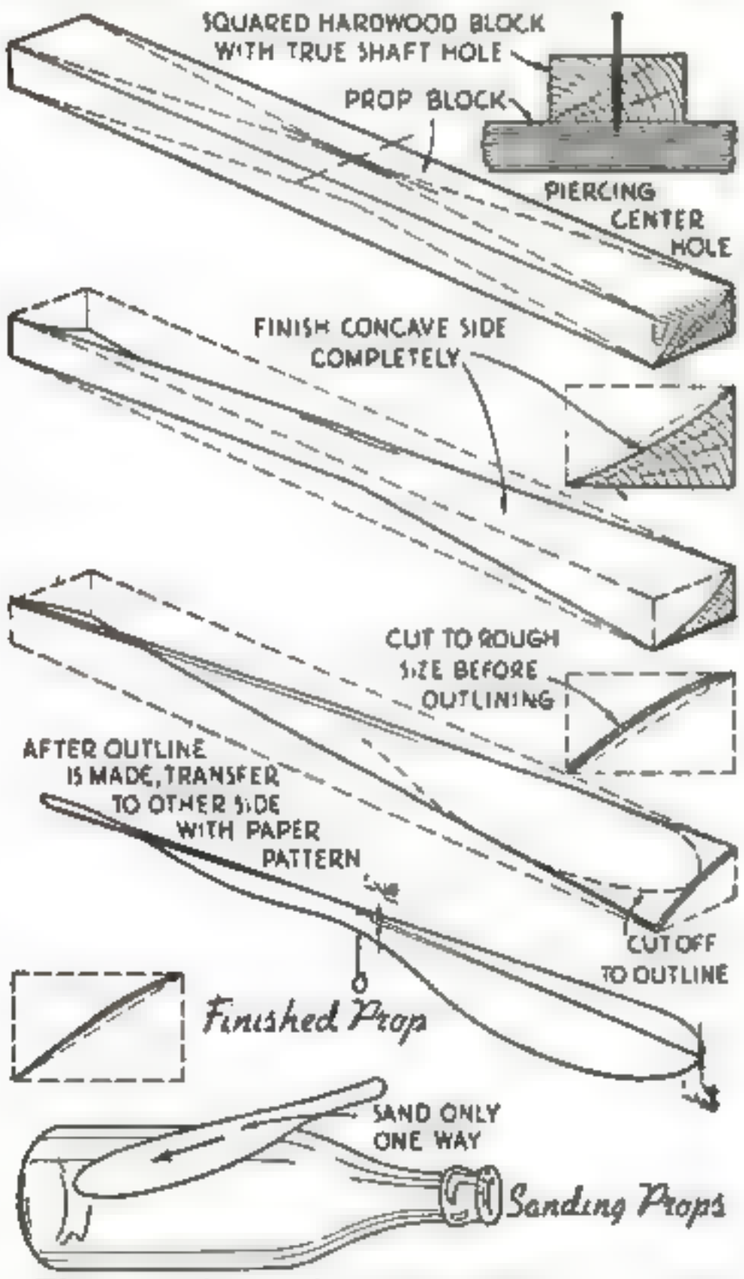
(Continued from page 120)

thinner, hold them against the light and look for thick portions.

Balance the prop in still air by inserting a fine wire in the shaft hole. If one blade is heavier, always feel the thickness to find where the extra weight exists, and also where it can be most easily spared. The leading edge should be thickest because it takes most of the shock.

Now comes the most interesting part—covering the framework with microfilm. Microfilm solution is made from clear commercial lacquer mixed with 1/10 oz. of castor oil to 1 oz. of lacquer by volume. Banana oil and flexible collodion, when mixed with castor oil, will also give satisfactory results. However, clear lacquer is preferable since it already contains other ingredients that strengthen the film. Be sure to mix the solution well. Heating the container by holding it under hot water helps to obtain a better mixture, but never heat it over an open flame because lacquers are very inflammable.

The film sheets are made by pouring a short, steady stream of the solution on the surface of perfectly clean and tepid water. The solution bottle should be held just above the surface to prevent splashing. The water may be contained in a half-filled bathtub, or a special wooden tank 2 by 20 by 40 in. may be made. Since lacquer and water do not mix and the lacquer solidifies the moment it touches water, a very thin film is made. The surface tension prevents it from sinking. The slightest trace



The steps in carving a paper-thin propeller. Much of the work is done with fine sandpaper

of soap in the water breaks up the surface tension and the solution does not spread. It is also hard to obtain a satisfactory film if the water is cold. The normal temperature is 75 or 80 deg. F. Since the strength of the film depends on its thickness, it is necessary to make several trial sheets to determine the working conditions.

The average thickness of the film is about 0.00004 in., so it must be applied by methods that require the least possible handling. It is now possible, in fact, to avoid touching it during the whole course of making and using the material. *(Continued on page 122)*

When Writing Advertisers Mention Popular Science

INDOOR PLANE MODEL

(Continued from page 121)

The film is removed from the water with a large hoop of ⅛-diameter aluminum or iron wire. This should be large enough to accommodate the wing with several inches to spare on each side. After the solution has spread, it should be allowed to set for about five minutes. The hoop is then lifted from underneath until it touches the film evenly on its entire perimeter. Continue the upward motion until the hoop is about ⅛ in. above the water. With the free hand, gather against the wire the film fringes. Then by lifting one side first, remove the film from the water by a sidewise angular movement of the hoop. Hang the film in a dust-free place and allow to dry.

The microfilm is transparent and sparkles. It is so thin that white light is broken up and refracted in spectrum-color wave lengths. This color refraction is one way of judging the film thickness. The shorter the wave length, the thinner is the film. Violet is of short wave length, and sheets having this color are used for small surfaces. Red has a much longer wave, and red film is consequently thicker. A good rule to follow is to use violet for small surfaces and apple green for wings.

THE simplest method of applying microfilm to the wing or tail is to moisten the spars and the center rib and tips with saliva, which acts as adhesive. Then lay the frame on the table and moisten the area around it with a wet rag. The film hoop is centered over the frame so that the best part of the film is used, and brought down and pressed against the table. The film will stick to the moistened area and draw down snugly against the framework, thus giving the saliva a chance to hold. The film can now be patted against the spars to insure perfect contact and left to set for about half an hour. Benzine-thinned rubber cement may be used instead of saliva as an adhesive, but since it is heavier, it should be used only when saliva fails.

The film is trimmed with a hot wire or an acetone-moistened stick. Keep the trimmer about ¼ in. away from the spars to prevent the film from melting over them. Be sure that the wire is reheated as soon as the film drags.

The tail surfaces can be cemented to the tail boom after they are covered. The wing is assembled by cementing the center portion of the rib first. After the cement has set, the spars can be brought together and cemented. This will give a neat center joint. Care should be taken when cementing near the film, because it is very easy to melt it.

Occasionally the film becomes wrinkled, either with age or careless construction. It can be smoothed by passing underneath it a hot object, which will tighten the film.

In transporting microfilm models, the film parts should be held in the box with very thin, soft paper, crinkled to prevent it from sticking to the film. Fasten it lightly on both sides of the wing with tacks. Also be sure that the part so fixed is not under strain.

Before flying the model, check the whole assembly for possible warping. The test flights should begin with about 300 turns. Gradually increase the number until the model is just below the girders or ceiling. For a longer duration in a large armory, the model is released as soon as the rubber is wound to its capacity, but in a small hall it is necessary to let out several hundred turns to use up the initial powerful torque.

In case the model gets caught way up, it can be retrieved by nudging it off with a hydrogen balloon. A small portable generator can be made from a quart bottle, zinc, and acid. Place several strips of zinc in the bottle and pour in a few ounces of hydrochloric or muriatic acid. Stopper the neck with a 5-cent balloon, and as soon as the balloon is filled, tie its opening with one end of a long thread. Then send it aloft on its dislodging mission.

ARE YOU SANE?

(Continued from page 25)

it over his hair, and make such a furious effort that the water would form in pools on the floor, often soaking through the ceiling below. Deaf at thirty, he never heard his most beautiful compositions.

One of the most horrible obsessions suffered by man tormented Mozart shortly before he died. He was extremely nervous and in the last months of his life he had a "dreadful fixed idea, a truly insane hallucination," as a friend described it. "He thought he was obliged to work on his own funeral mass! He constantly saw before him a man who commanded him to compose this requiem." Mozart himself said: "I always see him standing there; he hurries me, and incessantly asks me about it and urges me to compose in spite of myself, and when I wish to stop, the rest tires and harasses me more than the work."

CHOPIN was another composer who was extremely nervous. A wrinkle in a rose leaf or the shadow of a fly would exasperate him terribly.

Frederick II of Prussia had a mad dislike of changing coats. King though he was, he didn't have more than two or three coats in his life.

Goethe, the German poet, was given to external autoscopy. He often thought he saw his own image coming to meet him. He also had a suicidal impulse.

Oliver Cromwell was led on to his grim endeavors by a vision. Once, while he was lying on a bed, the curtains in the room parted and a woman of gigantic stature stood before him. In a resounding voice she told him he would become the greatest man in England—and he did.

Thomas De Quincey, who wrote "Confessions of an English Opium Eater" was quite eccentric even after breaking the drug habit. He would fail to appear for a lecture, or else would fall asleep on the platform. He had a brother who tried to learn to walk on the ceiling with his head down like a fly.

Edgar Allan Poe is the classic American example of a man of genius through whose mind ran dark thoughts and strange fancies. He drank "like a savage," one friend said, and was subject to the most horrible hallucinations. Monstrous forms or squirming vermin tormented him and some of the mental torture through which he passed is evident in his writing.

Then there was Jonathan Swift, the satirist. For an entire year he went without talking to anybody, without reading, and without even recognizing any of his friends.

Schopenhauer, the German philosopher, feared razors above all things. His phobia led him to burn off his beard instead of shaving. He also had a phobia toward noise and, like Swift, passed weeks without talking to anybody. He once refused to pay a bill because his name on it was spelled with two "p's" instead of one.

VICTOR HUGO and Balzac, two of France's best-known writers, were megalomaniacs—egotism was carried to the *n*th degree in their cases. Each thought that he was the world's greatest man. Balzac once bought a new dressing gown, donned it, and wandered down to the street so the crowds could admire him.

Emile Zola took the literary world by storm in the last century; but how did this man of genius act when not producing his searching novels? For one thing, he counted the gas jets on every street of Paris along which he walked! Numbers fascinated him, especially those on doors and cabs, and whenever he found a multiple of three he considered it *(Continued on page 124)*

ARE YOU SANE?

(Continued from page 123)

a good omen. So, too, were multiples of seven; but seventeen was an unlucky number. He not only was subject to arithmomania, but had an abnormal olfactory sense. Thus, he could sit in a distant room and tell what was being cooked in the kitchen, distinguishing by smell each kind of meat and vegetable.

Samuel Johnson didn't count gas jets, but he developed a protective obsession against the very real illnesses which afflicted him. When he walked from his home in London, Johnson would tap every pale in the fences along the sidewalk and if he missed one, he would retrace his steps and start over. He thought the rite kept him well for the day.

MEET a pair of hypochondriacs—Voltaire and Molière. Each was perfectly well, but imagined that he was very sick. Voltaire lived to be eighty-four, and for most of his life he thought he was dying, going around whimpering about his health and saying that he seldom complained!

Another French writer, Alfred de Musset, suffered from the curious internal autoscopy, and sometimes from external autoscopy in which he saw himself. Further, he thought sound had color, and to him a soprano voice was blonde and a contralto brunette. In his musical scale, "fa," for example, was yellow and "sol" red.

The French writers and poets seem to provide an astonishing number of mental abnormalities. Baudelaire, for instance, abused the use of opium, tobacco, and wine, and had a diseased passion for perfumes. He dyed his hair green. Gustave Flaubert was epileptic and felt auras. He would raise his head and cry: "I have a flame in my right eye!" Then: "I have a flame in my left eye; everything seems to be the color of gold." When writing of the poisoning of Madame Bovary he felt the taste of arsenic in his mouth and became very ill.

Guy de Maupassant was given to autoscopy and often saw his double. On going into a room he would see himself seated on a sofa! Maxim Gorki, the Russian novelist who died recently, had a suicidal impulse at eighteen and tried to take his own life. Tolstoy, another Russian writer, had an irresistible desire to fly in the air. One day he decided to try it. He locked himself in his study, stood on the windowsill, moved his arms in imitation flight, and plunged sixteen feet to the earth below.

THE list is almost endless, but one has been reserved as an astonishing example of how a human being can be sane in many respects; but still do utterly mad things at times. Gerard De Nerval, French political writer and poet, was ordinarily sane, but suffered from hallucinations. He would pass a fountain and imagine that the goldfish in it were putting their heads out of the water and trying to entice him to the bottom by telling him the Queen of Sheba was there.

Once De Nerval was seen pulling a live lobster at the end of a blue ribbon at the Palais Royal. He was astonished and indignant when stopped. Since other people could air cats and dogs on a leash, why couldn't he take a poor little inoffensive lobster, which was very quiet and didn't bark, for a walk?

He often tried to fly like a bird, and once was arrested on a street in Paris because he was waiting with outstretched arms for his soul to take flight—and in the nude!

Eventually, De Nerval brought his erratic but brilliant career to an end by hanging himself in a cheap room with an apron string which he thought was the girdle of Madame de Maintenon.

YOUR CHRISTMAS TREE

(Continued from page 33)

chased by communities for outdoor display.

The biggest Christmas tree ever cut and decorated was probably one set up last year in the plaza at Rockefeller Center, in New York City. Eighty feet high, it weighed six tons and had a trunk twenty-eight inches in diameter. It was a Norway spruce which had been growing for sixty years on a Long Island estate. It reached New York on a special trailer. More than a mile of wiring and 1,700 colored lights illuminated it. At the top was a lighted star, two feet, three inches high, containing seventy bulbs. Five electricians worked for nearly a week stringing the wires among the branches, and the lighted tree consumed more current in a single evening than the average family uses in two and a half years.

THE kind of a tree you trim when Christmas arrives, depends largely upon what part of the country you live in. Residents of the Northeast, for example, almost always get balsams. Farther south, in the Middle Atlantic States, red cedar is more common. If your home is in the Great Lakes region, your Christmas tree is probably a spruce or fir; if you live in a Rocky Mountain state, it may be a Douglas fir or a lodgepole pine; if you are a resident of the Pacific coast, you are likely to decorate a silver fir.

In fact, virtually every evergreen that is native to the United States is used somewhere as a Christmas tree. The least favored is the hemlock. The three most commonly used are spruce, balsam, and Douglas fir

To tell the three apart, examine the needles. The spruce has needles that are diamond-shaped. Those of the balsam, instead of narrowing at the base, widen out. When pulled away, they leave a round, conspicuous leaf scar on the twig. The Douglas-fir needles are similar to those of the balsam but are narrower and, when pulled away, they do not leave conspicuous scars on the twig.

A recent innovation, encouraged by the U. S. Department of Agriculture, is the "Christmas-tree farm." In all parts of the country, farmers are planting odd corners and waste land to evergreens, raising Christmas trees as a cash crop like corn and clover. Oftentimes, it is a profitable sideline that entails little work.

Almost any soil, except coarse sand and heavy clay, is suitable. The sand dries out too quickly in droughts, and the clay heaves with frost action and exposes the roots of the small trees. Because it grows more rapidly than other types of evergreens, the Norway spruce is most widely used. From 3,000 to 5,600 four-year-old trees are planted to the acre. If the soil is good, the evergreens can be harvested in from four to eight years afterwards.

DURING the first two or three summers, the little trees are cultivated like corn. Experiments at the Michigan State College of Agriculture and Applied Science, at East Lansing, show that cultivated Norway spruces, at the end of four years, grow fifty-nine percent taller than those which are not cultivated.

After the third year, a Christmas-tree plantation requires little attention. A fire line of from eight to a dozen furrows around the field will keep out grass fires which otherwise might kill the young trees. Barn-yard manure or fertilizer rich in nitrogen will help if the evergreens begin to turn yellow.

Because trees vary widely in rate of growth, some will be ready for harvesting long before others. On one plantation in Fairfax County, Va., for instance, trees that were planted in the same soil, at the same time, from the same stock, ranged all the way, at the end of four years, from trees six inches tall to others five feet all. By the *(Continued on page 126)*

If you like Popular Science Monthly why not pass the word along to your friends. When an article in this magazine strikes you as being unusually good, tell your friends to get a copy at the newsstand, and read it.

YOUR CHRISTMAS TREE

(Continued from page 125)

fourth Christmas, however, some of the trees should be large enough to sell, and each succeeding year others will reach marketable heights of from four to seven feet. By the time the plantation is ten years old, virtually all the trees should be big enough to harvest for market.

In Comanche County, Okla., tens of thousands of red cedars grow on one of the largest Christmas-tree plantations in the country. It is located near a main highway where motorists can stop and pick out the trees they want and take them away with them.

WITH the increase of apartments in large cities, there is a trend toward smaller trees. Those suitable for table use can be produced on Christmas-tree farms in from one to three years. Because of their freshness and fragrance, home-grown trees command the highest prices. And, unlike most farm crops, evergreens which are not harvested one year can be held over for the next without entailing any loss. Larger trees, from eight to fifteen feet tall, often can be sold to schools, churches, and fraternal organizations. Surplus trees can be left to grow into valuable timber.

In the South, not long ago, a curious experiment indicated that at least two crops of Christmas trees may be obtained from one setting. On a red-cedar plantation, the harvested trees were cut off just above the lowest branches. Then all of these lower branches except one were lopped off. The remaining branch gradually assumed a vertical position, and eventually produced another Christmas tree. Whether this plan can be adopted for other types of evergreens, remains to be seen.

In many parts of the country, a recent innovation is the use of living Christmas trees—growing evergreens in some park or square. Year after year, the same tree is lighted and decorated at yuletide. More than 300 communities have already adopted the idea.

In 1925, the largest growing thing on earth, the famous California redwood, General Grant, was selected as the "Nation's Christmas Tree." Located in General Grant Park, sixty-five miles east of Fresno, it is 266 feet high and is thought to be at least 4,000 years old. The patriarch of all living things, it is visited by thousands of travelers each year.

Even older than this redwood is the custom of decorating the home with green in late December.

Long before the Christian Era, people of Egypt were celebrating the winter solstice by placing green date palms in their houses as a symbol of life triumphant over death. When the Romans observed the feast of Saturn, they raised aloft a bough of evergreen. And both Greece and ancient Scandinavia held the fir tree in reverence.

HOWEVER, it was from Germany that the world got the custom of a lighted and decorated tree. Only in comparatively recent times, during the past century or so, has the idea spread to other countries. It was 1840 before the Christmas tree reached France. In Italy, even today, it is banned as being "a custom of purely foreign origin." Hessian soldiers who came from Germany at the time of the American Revolution are thought to have introduced the Christmas tree into the United States.

Half a century ago, trees were trimmed largely with red apples and strings of popcorn. Today, a vast industry supplies factory-made adornments. Only 115 years after a Catskill woodsman disposed of the first Christmas tree sold in America, it now requires an army of choppers, miles of flat cars, and hundreds of thousands of dollars in capital to meet the demand for Yuletide evergreens.

SCIENCE SEEKS ANSWER TO MYSTERY OF LIFE

(Continued from page 15)

From Switzerland, word recently reached this country that the noted Zurich chemist, Dr. Leopold Ruzica, has produced synthetic sex hormones. A hormone is a chemical substance formed in one organ and carried in the circulation to another organ upon which it exerts a stimulating effect. Roosters receiving injections of Dr. Ruzica's laboratory chemical developed combs that grew at an amazing rate, fully five times as fast as normal.

IN Washington, D. C., at the laboratories of the U. S. Department of Agriculture, Dr. Frank M. Schertz has spent years studying plant cells and chlorophyll, the green coloring matter of leaves. It is this chlorophyll which changes energy, in the form of sunshine, into matter, in the form of leaf pigment. What blood is to animals, Dr. Schertz concludes, chlorophyll is to vegetation. Plant life and animal life are so closely linked that the secret of one is believed to be the secret of the other. Consequently, research workers in many places are seeking to solve the riddle of chlorophyll.

In some of these studies, curious modes of plant cells aid in the work. At Tucson, Ariz., for example, Dr. D. T. MacDougal, of the Desert Laboratory of the Carnegie Institute, has produced an imitation cell by using a cellulose capsule. This he has lined with a jellylike mixture before filling it with specially prepared acid fluid.

During experiments, these synthetic cells maintained their acidity for days while immersed in an alkaline solution, just as the acid cells of the body do in the alkaline blood stream. Also, Dr. MacDougal reports, they exercised selective absorption of certain chemicals, such as sodium, chlorine, and potassium, when placed in soil solutions. This is what the cells of living root hairs do under similar circumstances.

Another Carnegie scientist, Dr. M. A. Spaehr, set up a cell model at the Plant Biology Laboratory of the Institution, in California, which "breathes" like a living cell. It takes in oxygen and sugar and combines them to form carbon dioxide and water, which is precisely what the living cell does.

Through such models, as well as through the more intricate apparatus which sustains or imitates life in the laboratory, scientists are seeking new clews to old mysteries. Gathering a fact here and another there, they are fitting together seemingly unrelated bits of knowledge in a sort of scientific jig-saw puzzle. When it is complete, it will answer the old query: "What is life?"

While the physicist works nearer to the heart of the atom and its secrets, the biologist is tackling the riddle of the cell and its spark of life. Laboratory advances in recent months give fresh hope of achieving the long-sought goal.

DOMESTIC AARD-VARKS MAY FIGHT TERMITES

IN ADDITION to dogs and cats, American homes may soon have aard-varks as pets. Domestication of the strange African anteaters is suggested as one way to control the devastating spread of termites, the small insect pests that eat wood, weaken beams and structural members, and often destroy whole houses. Since termites are as great a delicacy to aard-varks as mice are to cats, it is felt that the introduction and domestication of the African animals might halt or even decrease the spread of the wood-destroying insects. In spite of the ugliness of its face, which is designed for the practical work of breaking into termite nests, the aard-vark is said to have a gentle disposition.

GARDEN OF DRUGS GROWS RARE PLANTS

(Continued from page 43)

forty inches apart for ease in cultivation.

Digitalis cultivation started at the farm in 1930, mainly to provide digitalis leaves for the Pharmacy School laboratory to make into medicine for the University Hospitals.

As with all of the drugs, extensive research was carried out in order to determine the best ways of producing a high-grade medicine. The various methods of germinating the seeds were investigated, different methods of planting were tried, and the effects of various soils on the potency of the drug determined.

To improve the manufacturing methods, which consisted of drying the leaves, grinding them into a powder, and immediately making the pills or tinctures, various methods of drying were tested. Finally a simple process was adopted whereby the drying is carried on in air at ordinary room temperatures. Further experiments showed that the drug could be stored, in the powdered form, in sealed tins of fifteen pounds capacity, for many months without losing strength. When the ash content of the dried leaves was found to be too high, investigation revealed that washing them in cold water to remove sand and other impurities clinging to the hairy leaf surfaces would reduce the ash to a point below the maximum allowable level.

GRADUALLY, the average potency of the digitalis grown at the Cleveland farm increased, until that now being produced is about 150% the potency of that required by the United States Pharmacopœia.

The half-acre digitalis plots in the drug garden are harvested each year, when the plants are a year old. The dried leaves are converted, for the most part, into bright-green pills, although some tincture is made. In a year the University Hospitals use nearly 100,000 digitalis pills and several gallons of tincture; and all of these are made from plants grown at the drug farm.

Digitalis is but one of hundreds of drug plants under investigation and employed in the making of medicines for hospital use. Other plants grown include deadly nightshade (belladonna), from which is extracted atropine, used by physicians for dilating pupils of the eyes, relieving intestinal pains, and other purposes where muscles are to be relaxed; mustard, hemp, safflower, American wormseed, blessed thistle, sunflower, golden seal, henbane, camomile, Japanese mint, and Mexican datura, used for making a medicine to reduce pain or induce sleep.

Research on drug plants has numerous objectives. One important goal, in the case of some plants, is the uncovering of new sources of the particular medicinal substances that plant produces. Plants closely related to one that has become a standard source of some medicine are grown and studied to determine whether or not they might be better sources, or whether a substance derived from them would have better properties.

ANOTHER objective is the discovery of ways to produce synthetically valuable drugs that have so far been manufactured only in the cells of growing plants. The familiar pussy willow is a good example. From this plant can be made natural salicylic acid. This acid combines with acetic anhydride to form acetyl-salicylic acid, which is the well-known aspirin used for reducing pain. However, it is not necessary to grow pussy willows in order to produce aspirin tablets, for salicylic acid can be produced synthetically in the laboratory or chemical plant, from sodium phenolate and carbon dioxide gas. In a similar way, many of the common medicines and drugs now derived from vegetable *(Continued on page 129)*

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(Seal) My Commission expires March 30, 1938

GARDEN OF DRUGS GROWS RARE PLANTS

(Continued from page 128)

plants may, some day, be made in manufacturing plants of brick and steel.

Besides affording valuable opportunity for research, the drug gardens enable future pharmacists to become personally acquainted with the things they someday will be making into medicines. Working in the manufacturing laboratory operated by the School of Pharmacy, students actually go through the processes of transforming the crude drugs into pills, ointments, tinctures, and other medicants to be used in the University Hospitals.

BEFORE the drugs produced on the farm are administered to patients, they are subjected to exhaustive examination and test, to make sure they will do the work expected of them. They are tested analytically and, if necessary, are administered to experimental rabbits, guinea pigs, rats, and other animals to test their effects. Finally, they may be used in filling prescriptions in the hospital pharmacy.

Operated by a trained staff, the pharmacy is very much like the prescription department in a drug store. There medicines are prepared according to prescriptions written by physicians for patients both in the hospital and at home. In this activity alone, much money has been saved as a direct result of growing the ingredients on the drug farm. The work has been instrumental in lowering hospital expenses for medicine, providing in many instances better medicinal materials than were obtainable before and lowering the retail prices of medicines made by manufacturing companies.

Dean Spease's work, begun years ago in his first dandelion patch, is now bearing fruit. The Western Reserve system, with its drug garden and other facilities for the proper training of students, and with its methods of growing and testing its own medicinal plants and preparing and distributing the medicines used in the University Hospitals, has become a model for the guidance of pharmacists, physicians, and hospitals in many parts of the world.

USE SOUND VIBRATIONS TO AGE WHISKY

WHISKY can be artificially aged by subjecting it to intense sound vibrations, according to Dr. L. A. Chambers of the University of Pennsylvania. "Bombarding" raw spirits with sound waves for seven hours is said to be equivalent to aging whisky in wooden casks for four years. The sound barrage vibrates at 1,200 cycles a second with an intensity said to be 100 times that of a full symphony orchestra.

FIND SIGNS OF LIFE IN THE DEAD SEA

LIFE has just been found in the Dead Sea. Scientists, examining samples taken from Palestine's largest body of water, recently discovered the presence of three distinct forms of microscopic life. Heretofore, the water in the Dead Sea has been thought to be completely devoid of any kind of living organism, due to its high content of salt, potash, and other mineral matter.

CURE FOR MUSTARD GAS

BATHING the skin with chlorinated lime and water will minimize the bad effects of contact with mustard gas, according to a recent announcement by a Swiss physician. Suffering, permanent injury, and death from this poison gas in a future war may be prevented by setting up tubs of limewater mixture in front-line trenches, and near field hospitals.

HOME CHEMISTRY WITH SIMPLE APPARATUS

(Continued from page 57)

clamp and drawing off a little of the bottom liquid into a test tube, the medicine-dropper arrangement acting as an improvised separatory funnel for this purpose. The presence of alcohol in the water may then be proved by a simple chemical test.

If you used grain, or ethyl, alcohol for the experiment, add several drops of strong sulphuric acid and a drop of acetic acid to the liquid sample you have drawn off. Then heat the contents of the test tube. A fruit-like odor, resulting from the formation of a compound called ethyl acetate, shows the presence of ethyl alcohol.

IN CASE you used wood, or methyl, alcohol for the test, add a small quantity of salicylic acid crystals and several drops of strong sulphuric acid to the drawn-off sample. When the test tube containing this mixture is heated, the odor of methyl salicylate, or artificial oil of wintergreen, will indicate that methyl alcohol was present.

Solids as well as liquids diffuse through the movement of their molecules. This action can be demonstrated by a very simple experiment. All you will need is some clear gelatin and two dyes of different colors.

Prepare a solution of the gelatin and make three molds into which it can be poured to form slabs not more than two inches square and about as thick as a slice of bread. After the molds have been poured, add different-colored dyes to two of the slabs, leaving the third clear.

When the slabs have set, place them together sandwich-like, with the clear piece in the middle, under a glass tumbler so that the gelatin will not become dry and brittle. Allow them to stand this way for several days. Examine them daily and you will see that the colors of the two slabs containing dye slowly make their appearance in the clear portion, indicating that diffusion has taken place between the solid pieces of gelatin.

CHLORINE BATH INSURES OYSTERS' GOOD HEALTH

AN OYSTER laundry where the succulent shellfish take internal and external baths has just been started in England. Here oysters gathered in waters that are suspected of pollution are first hosed down, and then tossed into tanks of chlorinated sea water from which the chlorine smell and taste have been removed. The oysters obligingly suck in streams of the sterilized water, which washes away sand and grit as well as any germs that may be present. Since the oysters object to chlorine, they are next shifted to a bath of untreated chlorine water to make them close up tightly, thus keeping a shellful of sterile sea water inside as they are shipped to market.

REËNACT GREAT FLOODS ON MODEL MISSISSIPPI

TO STUDY the cause and prevention of floods, engineers are reënacting disastrous inundations of the past with the aid of a giant model of the Mississippi River erected at the U. S. Waterways Experiment Station at Vicksburg, Miss. More than 1,100 feet long, the huge model reproduces in miniature the territory from Helena, Ark., south to the river mouth, comprising 602 miles of the main river channel and its principal tributaries, a section covering a total area of 16,000 square miles. Forty-two engineers, operating seventeen separate water valves and reading over 210 recording gauges, are required to reënact a major flood on the model.

HOW POPULAR SCIENCE IS PUT ON THE SCREEN

(Continued from page 36)

hour later, they drew alongside the test plane almost three miles above the earth. Fairbanks adjusted his camera, tripped the switch, and signaled Breese he was ready. For a few seconds the two planes flew parallel. Then Breese dropped the nose of his ship and started down. The pilot of the camera plane, misunderstanding his orders, shoved the stick forward and followed. Fairbanks was thrown off his feet by the suddenness of the maneuver. Before he could shout to the pilot, the plane was screeching downward in a hair-raising plunge.

"The ship wasn't stressed for a 400-mile-an-hour dive," he told me, "and every second I expected to hear the fabric ripping from the wings. But the pilot pulled her out safely and we got a beautiful shot of Breese's dive."

WHILE most of the subjects are shot as silent films, the producers keep notes as they develop the subject. Later, Gayne Whitman, radio announcer, takes these notes, studies them, views the assembled scenes on a small screen, and gradually builds up his explanatory narration. Often, he intersperses humorous comments along with the informative material. For the comic as well as the serious finds a place in this screen record of advancing science.

The picture that evoked the most laughs showed a hitch-hiker trotting along a country road carrying a five-gallon gasoline can. He thumbed a ride that carried him several miles to the nearest service station. Then, sitting comfortably on the side of the road, he opened the can which proved to contain his lunch, extra clothing and even a shaving outfit. "Not a roadside bummer," commented Whitman, "but a scientific thumber."

In their constant search for novelties in science and invention, Fairbanks and Carlisle employ their Hollywood laboratory merely as a basis of operations. There they keep their equipment in readiness, for tomorrow the trail may lead into the deserts of New Mexico, into an industrial plant in the East, or to the forests of the Northwest, to bring some new and fascinating subject to the screen.

MEN HUNTED MAMMOTHS IN ANCIENT AMERICA

MAN-MADE spear points, recently found in New Mexico among the remains of prehistoric elephant bones, definitely establish that North America was inhabited as long ago as 8000 B. C., according to prominent archaeologists. Antiquity of the findings was established by a geological examination of the sub-surface strata in which they were discovered. From the position of the elephant bones and stone spear points on the site where they were found, scientists deduce that the mammoths were trapped in a bog and killed with stone-headed spears. One of the weapons was found lying under a vertebra, another under a shoulder blade, and a third between the forelimbs of a beast.

SYNTHETIC DESERT AIR MADE FOR INVALIDS

HEALTH TRIPS to dry desert regions may soon become unnecessary, if a new treatment devised by a German scientist proves successful. According to his statement, the beneficial influence of desert air on persons suffering from certain ailments is due to the character of the dust present in the air. This dust can be reproduced chemically, he claims, and can then be blown into a room with a fan and breathed by a sick person in the comfort of his own home.

GUS GIVES SOME TIPS ON TRAILERS

(Continued from page 62)

the trailer when it isn't attached to the car."

"Why not make them with four wheels, so you wouldn't have to bother with that clumsy jack affair?" Pendleton asked. "The truck trailers I see going along the road have four wheels."

"You could make a motor trailer that way, too," Gus agreed, "but it would make the whole construction much heavier and more complicated. Either the front axle would have to swivel, as it does on a horse-drawn wagon, or you'd have to mount the front wheels on king-pins and put in some trick mechanism so the trailer would be automatically steered by the bar connecting the trailer with your car.

"NO, THAT wouldn't be worth while," Gus went on. "Two wheels on a single axle placed a little back of the center of gravity, so that 200 or 300 pounds of the trailer weight is carried by the back of the car, seems to be the best combination. Incidentally, that extra weight, plus the fact that the trailer presses down harder when you put on the brakes, makes it considerably easier to stop the car."

"How about having brakes on the trailer wheels, too?" Pendleton suggested.

"You can get them if you want them," said Gus. "If your car has hydraulic brakes, it's a cinch to put hydraulic brakes on the trailer wheels and hook them up so they work from the brake pedal along with the car's brakes. Or, you can put on a vacuum-operated brake outfit. But considering how much better a trailer makes the brakes on your car work, most people don't bother to have brakes on the trailer except for service in very mountainous country."

"I suppose you'd have some kind of a quick-detachable coupling for the brake connection, wouldn't you?" Pendleton suggested.

"That would be easy," said Gus. "It could be made to work with this cable connection that hooks up the tail and stop lights on the trailer."

Pendleton examined the end of the cable plug. "You just plug this into a similar one on the back of the car when you hook on the trailer, eh? Neat idea, that. And I suppose the trailer is lighted inside from the car battery, isn't it?"

"Most trailers are," Gus explained. "A lot of them being built now are wired for 110 volts and there is a plug connection, so when you are in a camp that supplies electric current you can plug in the outside juice and put 110 volts on the sockets. Changing the bulbs is a bit of a nuisance, though, so I rewound an old radio power transformer to give six volts on the secondary. We've got it hooked up so all we do is plug in the outside current and throw a switch, and the six-volt bulbs burn on the outside juice stepped down to six volts.

"OF COURSE," Gus added, "if you're staying for quite a while in a camp where there is no electricity on tap, and if you don't make side trips in the car every day to keep the battery charged, you'll have to use a kerosene lamp or a gasoline camp lamp like this."

He opened a locker and pulled out a lamp of the type that uses an incandescent mantle.

"Well," said Pendleton as he leaned back on one of the cushioned bunks and examined the fittings of the screened window, "it certainly is a comfortable little home on wheels. Gives me about the same sensation I'd have in the cabin of a trim little motor boat. What do you do about keeping warm in winter?"

Gus laughed. *(Continued on page 133)*

GUS GIVES SOME TIPS ON TRAILERS

(Continued from page 132)

"One of the advantages of living in a motor trailer is you can follow the birds south in the fall, and you needn't ever stay where it's cold enough to need heating. But if you do, an ordinary small oil stove will heat up this small space in no time at all. In fact, you'll have to turn the burner 'way down to keep from getting too hot."

"Yes, that would be the solution, all right," Pendleton agreed. "And I suppose if you were in a camp where street current was on tap, you could use a small electric heater and avoid the kerosene smell. Heat insulation would help a lot on that. Is there any heat insulation in this outfit?"

"SURE," Gus replied. "There's a double floor with a layer of cork board between the layers, and the walls and top have heat insulation between the outside and inside surfaces. But the purpose of the insulation is not so much to make it easy to heat in winter, as to help keep it cool in summer. Most camps that cater to trailer tourists fix things so that you can park under a tree, but if you had to park out in the sun, the inside of this outfit would get as hot as an oven in no time at all without the insulation."

"Guess it takes quite a little more gas to tow an outfit like this doesn't it?" Pendleton questioned.

"Bring up that subject with a motor-trailer enthusiast, and you'll have a real argument on your hands," laughed Gus. "Of course, it stands to reason that you can't pull an extra couple of thousand pounds along without using more power to do it, and more power means more gasoline burned. But the increase is not at all in proportion to the increase of your load.

"Suppose, for instance," Gus continued, "that your car weighs, say, 3,000 pounds or thereabouts, and your motor trailer weighs in the neighborhood of 2,000 pounds. Adding the trailer would increase your total load to 5,000 pounds. If weight were the only thing that counted, and you get fifteen miles to the gallon without the trailer, you should get only nine miles with it. Actually, you'll probably only do a mile or two less to the gallon with the trailer than without it."

"How do you figure that out?" Pendleton asked.

"IT'S all a matter of friction and wind resistance," Gus pointed out. "On level ground, it takes mighty little power to overcome the friction of a pair of roller bearings, even when they are loaded with 2,000 pounds, and the wind resistance at moderate speeds doesn't amount to much if the outfit is streamlined a bit. So the only time you really use more power is in getting the load started and in pulling up hill. Part of this you get back, because the extra weight makes you coast better on gentle down grades. Of course, if you *will* burn up the road at high speed, the wind resistance is bound to make a difference."

"Want to sell this outfit?" Pendleton asked suddenly.

"Not on your life!" Gus grinned, "but I can give you the names of some concerns that make trailers of about the same type."

"Who are they?" Pendleton asked, fishing out a notebook and pencil. "My landlord's getting a bit uppity. Guess I'll walk out on him, buy a trailer, and the wife and I will head for Florida for a couple of months. I can afford it if I don't have rent to pay here."

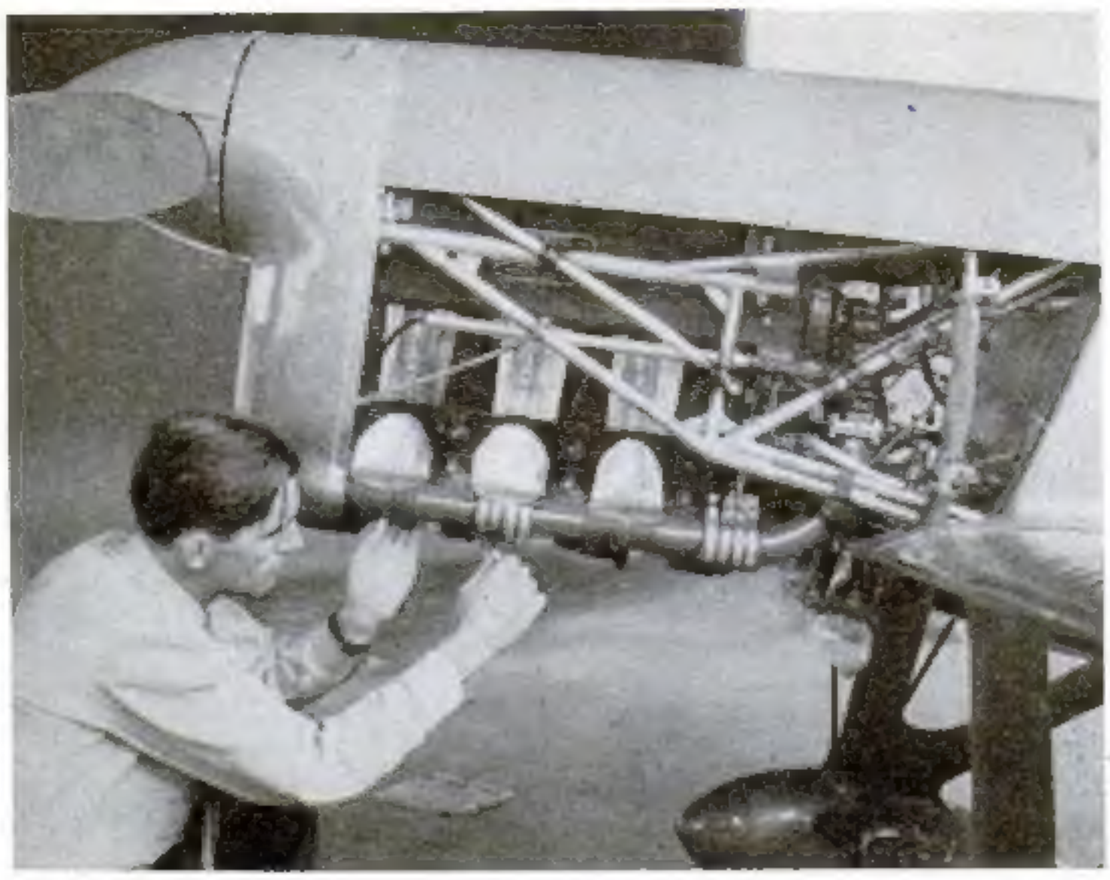
"He won't be the first landlord that has been handed a jolt like that these days!" Gus chuckled, as he pulled a bunch of trailer catalogs out of a drawer.

Tiny Homemade Planes Bring New Air Speed

(Continued from page 27)

pilots who fly in races one season will spend possibly $2,000 to step up the speed for next season. Fixed landing gear disappears, and retractable gear takes its place. Wings are shortened, and flaps are installed to slow down landing speed and make the flying gas tanks just a little safer.

Since each plane has a winning life of only three years, pilots exert themselves to put all the speed possible into a new job, hoping it will win first money in the various races first time up. But the hazards of racing are nothing as compared with the dangers of testing. Imagine yourself strapped astraddle a broomstick, hurtling through the sky at 250 miles an hour, diving on a measured course at 300 miles an hour for a speed check, dropping like a brick with a "dead stick" for what threatens to be a disastrous landing.



Lee Miles, one of the country's leading builders and racers of small planes, making final adjustments on his engine mounting before a flight

"Whenever you walk away from a landing," the pilots say, "you have made a good landing." Ralph Bushey, young Inglewood, Calif., pilot and plane designer, failed to walk away from one. He built a low-wing monoplane which he thought should do at least 260 miles an hour. After testing the inverted, air-cooled engine on the ground, he hopped off for a series of test flights. On his first six hops, he ascended only high enough to clear the fences and power lines around Mines Field, testing latitudinal and longitudinal stability. Gradually he opened the throttle until, on the sixth flight, his 214-pound engine was turning 2,800 revolutions a minute, pouring out 265 horsepower to the spinning propeller.

ON THE seventh, he climbed to 7,000 feet. There, while feeling out the plane, his air speed meter indicated 230 miles an hour. Suddenly, his motor quit.

"I was going like a bat one moment," Bushey told me later, "and the next I was dropping like a stone, hoping to get down right side up. You know, landing at 100 miles an hour with no prop to pull you along is quite a trick, particularly when you have no shock absorbers. Well, I had no 'chute, and therefore no choice. Boy, was that landing stiff! I had forty pounds of air in the tires to help the take-off, instead of the usual ten. It felt almost like I was skidding along the runway on the seat of my pants."

Bushey repaired the ailing fuel line, and later took off to check the little plane's speed on a measured course. He spiraled upward, swung out over the Pacific Ocean, dived 3,000 feet onto the course to pick up all possible speed, then flattened out so the clockers could catch him going by in level flight. From 300 miles an hour at the foot of the dive, the air-speed meter settled back slowly to 280 . . . 270 . . . 260 . . .

Then, as though a knife had sheared the supports, his propeller, cowling, and motor dropped from the nose of the tiny craft. Instantly, Bushey cut the switch, hoping to save enough of the plane to rebuild it for forthcoming races, and a moment later rocketed into two hay stacks a mile from Mines Field. The two mounds of hay saved him from what seemed certain death, and for seven months Bushey lay on a hospital bed congratulating himself on his lucky escape.

Because of the small wing area, the pilots never bring the abbreviated racers down at a gliding speed. They literally fly them to earth, touching the wheels to the runway twenty to thirty miles an hour faster than they could land without the engine, for the sole purpose of maintaining control. For to drop below a safe landing speed means that the engine would pull a ship nose-down into the earth. Since some of the planes have only thirty-six square feet of wing area, speed is essential to maneuverability at both high and low altitudes.

When an engine fails, a pilot wastes no time in seeking out a landing place and dropping the nose toward a flat space on the earth. "These ships glide like bricks," commented Lee Miles, one of the veteran pilots, before jumping off for a test flight recently.

Ten minutes later, Miles was easing along only 200 feet up, when his motor stopped. He shoved the stick forward, jumped the plane over a triple bank of power wires, struck a guy wire with his propeller on the way down, and landed between two rows of parked automobiles with only inches to spare. "That breaking guy wire sounded like the plop of a rifle," he said, after his ship stopped rolling. But it left no more than a smudge on the leading edge of his propeller.

On another test flight at Springfield, Mass., Miles was taking off with a tankful of gas and a load of sand when the engine quit. His wheels touched earth at a speed well above 110 miles an hour. Immediately he jammed on his brakes and skidded 450 feet, stopping less than six feet from what seemed a sure crash.

R. A. Kling ferried his ship from his garage at Lemont, Ill., to Cleveland, where he undertook a thirty-minute test flight. He took off without difficulty and was breezing along the tree tops well above 200 miles an hour, when suddenly something struck him a terrific blow on the forehead. "Automatically," he related, "I pulled back on the stick. When I regained consciousness, I was up 3,500 feet."

OBSERVERS on the ground told him, after he landed a few minutes later, that the cockpit cover and the hatch had torn away without warning, knocking him out as they flew past his head. Flying parts tore out three ribs from the right wing and ripped a gaping hole in the leading edge. Within a few weeks, Kling had repaired the damage and was once more speeding through the sky in his tricky racer.

Some of the pilots put their ships through only a few maneuvers, but others give them everything in the book. Joe Jacobson runs severe tests on his ship after every structural change, from spinning it, to diving it to terminal velocity and pulling out sharply. He starts at 6,000 feet, over the Kansas City airport, where he conducts a flying school, and completes his dangerous evolutions well above 2,000 feet. That gives him plenty of room to attempt a recovery if anything goes wrong.

He starts his spins with a single turn, then makes two turns, and increases until he's wrapping the ship up in six or seven tight turns. First he tries the spins with the ship empty, then fully loaded with gasoline and sandbags. Following these severe tests, he dives the little ship until it reaches terminal velocity, around 300 miles an hour, when he pulls out. If any wing flutter or vibration is ever to develop, the fault will show up during this vertical dive.

"She's a tricky little baby," he explained when I asked why he subjected the plane to such severe stress. "She had no adjustable stabilizer, and if the engine is not O.K. and she's out of balance—tail-heavy or nose-heavy—I could get into a lot of trouble with the little devil. So I give her the works before I'm bothered trying to dodge other planes in a race."

Because the cockpits are so tiny, few of the pilots carry bulky parachutes. Yet they dare to fly the little machines far from their home ports, and occasionally engine failure, storm, or fog drives one to earth. How they bring their ships down at high speeds and remain upright is still a mystery even to the flyers themselves.

ALTHOUGH the newer planes are equipped with retractable landing gear, the pilots prefer to bring them down on their bellies rather than on their wheels once the prop has stopped turning.

"Why take that chance?" I asked Jacobson, as we stood near the edge of Mines Field in southern California, watching Harry Crosby bring his new low-wing job in for a landing.

"He's comin' in hotter'n a firecracker now," Jacobson explained, "and if he had some prop drag to fight, he'd drop pretty fast. On wheels he might roll into trouble, or ground-loop; but he could come in on the fuselage and skid to a stop in a fifth the distance."

What you and I see when these planes are cavorting around the skies are pilots with nerves of steel, and planes capable of taking tight vertical turns around the pylons. But they represent far more than merely a thrill. Many of the larger planes, and their refinements, are copied from these. On these appear the newest developments and devices as soon as inventive minds turn blueprints into practice.

IN THE past, the fast racers were wire-braced and strut-braced, with no retractable wheels. Now, the speediest jobs carry fish-like bodies, with no external struts and wires, and their wheels fold up into their bodies. Cleancut bodies and wings swept the field at the National Air Races at Los Angeles this year, as Roger Don Rae demonstrated by whizzing around the course at 248 miles an hour in his full-cantilever Rider racer, a machine that looks small enough to be trundled under the bed at night. And they're the product of daredevil designers who spend their own money and risk their own lives to prove that the dangerous little ships are built to get up and go places.

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